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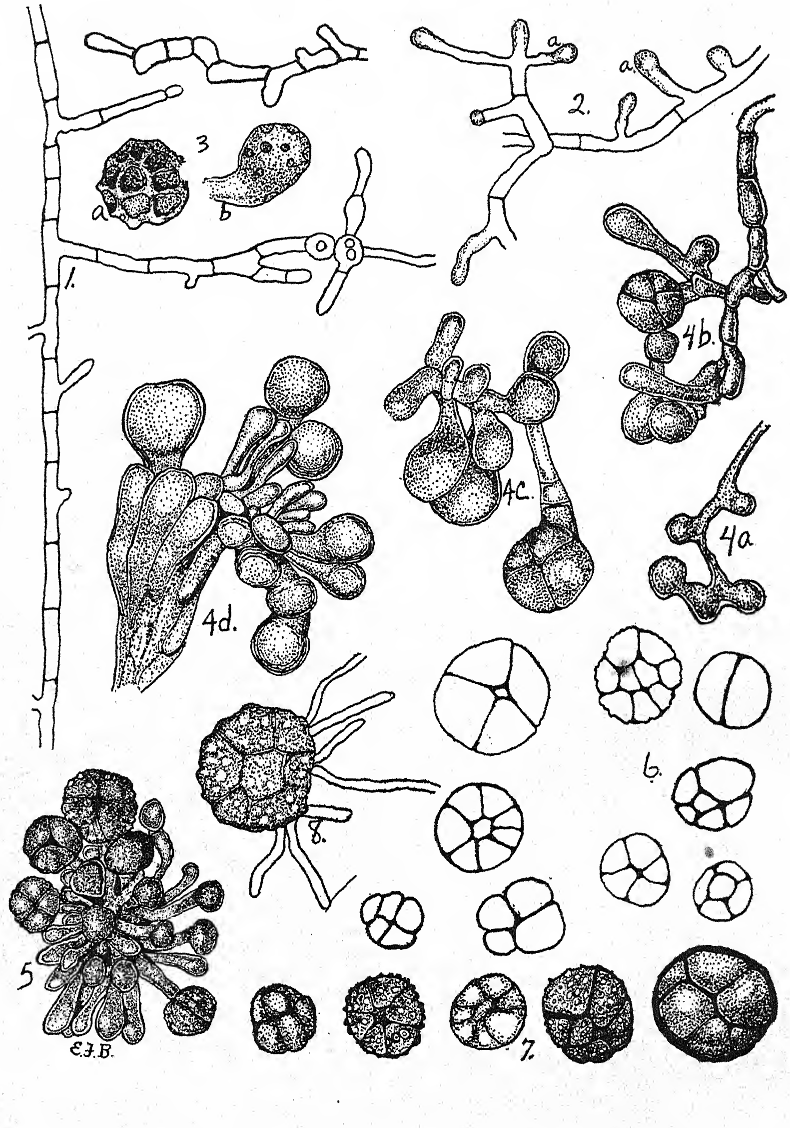

THYROCOCCUM HUMICOLA BUCHANAN

MYCOLOGIA

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A NEW SPECIES OF THYROCOCCUM

R. E. Buchanan

(With Plates 34 and 35, Containing 10 Figures)

The isolation in pure cultures of a hyphomycete at first referred to the genus *Epicoccum* has recently afforded an opportunity for a study of this form. It has been found on several occasions growing on dextrose, nitrogen-free, agar plates prepared from dilutions of a black loam soil rich in humus. The life history of the members of this genus, particularly the development and septation of the spores, seems to be imperfectly understood.

The genus *Epicoccum* Link is characterized by its dark, unicellular (or rarely multicellular) spores, borne singly on conidiophores massed in a dense sporodochium. The septation of the spores is not easily observed, and doubt has been expressed as to whether these so-called septa are not merely superficial markings. Lindau (Rabenhorst's Krypt. Flora 9: 595. 1909) says: "v. Höhnel hat vorgeschlagen, die Gattung zu Teilen und die Arten mit einzelligen Konidien bei *Epicoccum* zu belassen, und die mit mehrzelligen Konidien zu Thyrococcum zu stellen. . . . Wir wissen nämlich nicht ob die einzelligen Konidien sich nicht doch später noch teilen. Ferner kennen wir die Art der Teilung der Konidien nur bei wenigen Arten genauer und auch hier bleibt noch eine gewisse Unsichbarkeit zurück. Sie liese nur damit haben, dass man die Keimung der Konidien beobachtet, um dadurch zu sehen, ob wir es mit einem Konglomerat von Konidien

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oder mit einer einheitlichen Konidie zu tun haben. . . . Diese Schwierigkeiten könnten nur durch eine genaue Untersuchung der Konidienbildung und -teilung behoben werden."

The mycelium of this organism develops readily in a variety of media, most luxuriantly in those containing dextrose. Mannite N free agar, dextrose, starch and mannite N free nutrient solutions, solidified blood serum, dextrose and peptone gelatin, and peptone solutions all support good growths. The hyphae are much branched, and cross and recross in every direction. For the most part, they remain near the surface of the medium, the organism being a strict aërobe. The hyphae vary considerably in diameter, from 3 to 8 μ. They are septate and usually granular. The mycelial threads lying in the medium are hyaline and colorless, at least when young; from them is diffused a pigment, which is brown in dextrose and lemon-yellow and later brown in mannite media. This pigment is soluble in alcohol and in water. Aërial hyphae are developed in considerable numbers. In the absence of an excess of moisture, these produce the sporodochia and the spores; in a saturated atmosphere, they form pink or brown masses of hyphae several millimeters in diameter. The hyphae lying in the medium show marked antibiosis toward the hyphae of certain species of *Penicillium* and some other molds.

The sporodochia arise from the aërial hyphae. Certain threads branch and rebranch to form a dense mass, or sporodochium, from which the conidiophores develop. The tips of the latter become fuscous and swell to form the spores. The conidiophores are from 5 to 25 μ in length, and septate when long. The spore is not readily broken off. These sporodochia are usually spherical or ovoid and vary in diameter when mature from 50 to 500 μ. The young sporodochia may be early recognized by the fuscous tips of the branches of the aërial hyphae.

The sporodochia and spores are not developed readily in a saturated atmosphere. A thick layer of agar, for example, in the bottom of a Petri dish will prevent the formation of spores, although under these conditions there may be an abundant production of aërial hyphae. If the cover of such a plate be removed and the surface of the medium allowed to dry somewhat,

the beginnings of sporodochia may be found in great abundance within twenty-four hours.

The spores are spherical, rarely becoming somewhat irregular by the distension of one or more cells. They are 10–25 μ, usually about 20 μ, in diameter, brown when young, when mature opaque, shining, coal-black, and waxy. The mature spores are multiseptate. The septa begin to appear when the spore is two thirds grown, but the mature spores are too opaque to reveal the internal structure readily, although in a few individuals the septa may be seen. There can be no doubt of their septate character after an examination of Plate 34, figures 4 to 7, and particularly Plate 35, figure 2, which illustrates the many tubes which issue from a germinating spore. As suggested by Lindau in the quotation above, we may refer this species to the genus *Thyrococcum* rather than *Epicoccum* on the basis of the septation of its spores. It is possible that several other species with occasionally septate spores that have been described as *Epicoccum* belong to *Thyrococcum*. The septa in some cases radiate from the center and give the spore the appearance of a musk-melon with longitudinal grooves. More frequently, however, they are placed irregularly. The surface of the spore is areolate and somewhat tuberculate. A diagnosis of the species follows.

Thyrococcum humicola sp. nov.

Hyphis sterilibus, decumbentibus vel assurgentibus, in agar hyalinis, in aere fuscis, roseis vel brunneis, multis ramosis, septatis; sporodochiis orbicularis sparse gregariis vel separatis, raris confluentibus, 50 to 500 μ diam., fuscis; conidiis, sphaericis vel raris irregularis, multo-septatis, dictyosporis, 10–25 μ in diam. non stipitatis, reticulatis, verrucosis, primo atrobrunneis denique nigris.

Hab. in dextrose agar pulvere terrae humosae infecta.

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EXPLANATION OF PLATE 34 (frontispiece)

1. Mycelium grown on dextrose agar plate. × 1000.

2. Aerial mycelium showing the fuscous tips of the branches, the beginning of a sporodochium. × 1000.

3. Young spores. × 1000.

4. Young sporodochia in various stages of development. × 1000.

5. Young sporodochium. × 1000.

6. Outlines of spores, showing variety of septation. × 800.

7. Spores, matured, showing septa. The distinctness of the walls is somewhat exaggerated. × 800.

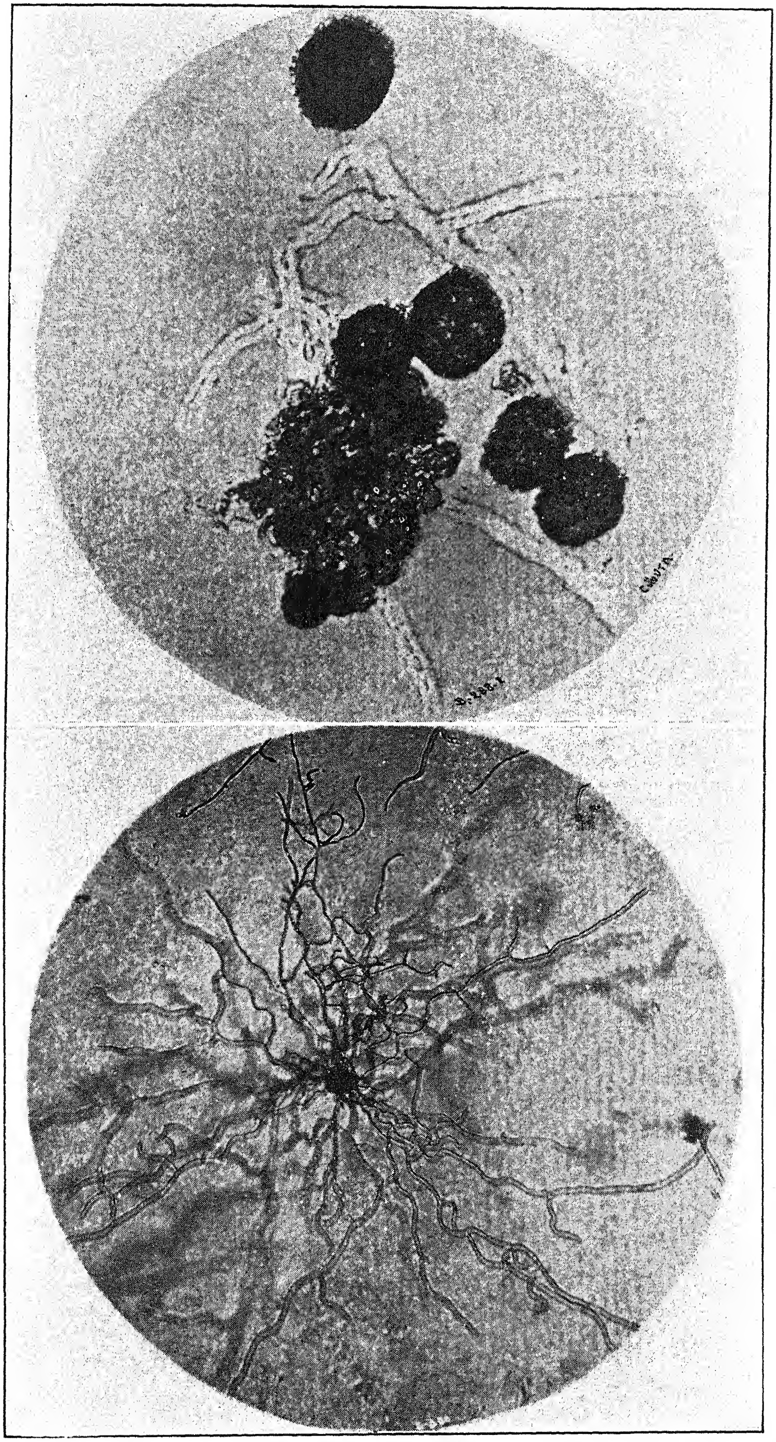
8. Germinating spores, showing the hyphae originating from several cells. × 800.

EXPLANATION OF PLATE 35

1. Microphotograph of young sporodochium on aërial hyphae. Some of the spores may be seen to be septate. On dextrose N-free agar. × 1000.

2. Microphotograph of single germinating spore. Note that the hyphae originate from many points on the surface. Higher magnification shows the spore to be multiseptate and hyphae originate from different cells, frequently several from a single cell. × 400.

This plate is reproduced by courtesy of the Iowa Agricultural Experiment Station.



THYROCOCCUM HUMICOLA BUCHANAN

NEW SPECIES OF TEXAS FUNGI

F. D. Heald and F. A. Wolf

In the spring of 1909, the writers, in cooperation with the Bureau of Plant Industry, of the United States Department of Agriculture, began a Plant Disease Survey of the area designated as the San Antonio-Austin area. This area included the territory within a radius of one hundred miles of San Antonio, and collections were made at many points.

Parasitic species occurring on both wild and economic plants were collected, but attention was given chiefly to cultivated crops. As a result of this work, forty-one new species have been described and a total of two hundred and ninety-three species, on one hundred and ninety-three different hosts, have been recorded. They are distributed as follows:

	Species
On tree fruits	30
On small fruits	7
On truck crops	33
On cereals and field crops	13
On forage crops and grasses	25
On trees and shrubs	90
On greenhouse and garden plants	27
On wild plants	68

The complete report of the Plant Disease Survey is being published as a bulletin by the United States Department of Agriculture, and will contain figures illustrating practically all of the new species, descriptions of which are published here.

Dimerosporium Parkinsoniae

Myceliis effusis, brunneis, septatis, ramosis; conidiis atrobrunneis, 1–4 loculis, muraliformibus; peritheciis gregariis, atris, subglobosis, ascis 8-sporiis, $45–50 \times 12–15\,\mu$, sporidiis hyalinis, inaequaliter biloculis, guttulatis, $15–18 \times 4–6\,\mu$.

On *Parkinsonia aculeata* L. Austin, *455;* Seguin, *2311* (*type*); Gonzales, *2658;* Hallettsville, *2901.*

The leaves and smaller twigs and even the smooth bark of larger branches are sometimes covered with sooty patches made up of dense aggregates of the brown septate hyphae.

Phleospora multimaculans

Maculis numerosis, definitis, irregularibus, orbicularibus v. angulatis, atro-brunneis vel purpurascentibus, 1–3 mm. diam. confluentibus, saepe partem majorem foliorum insidientibus; pycnidiis hypophyllis 30–45 μ diam.; sporulis cylindraceis, rectis curvulisve, 1–4-septatis, hyalinis, 20–50 $\times$ 3.5–5 μ.

On *Platanus occidentalis* L. Austin, *1398, 1535;* Brenham, *1462;* New Braunfels, *1682* (*type*); Llano, *1767;* Victoria, *2503;* Gonzales, *2655;* Floresville, *2558.* On *Juglans nigra* L. Austin, *1538, 2426;* Victoria, *2337;* Stockdale, *2621;* Gonzales, *2682;* Flatonia, *2721;* Falfurrias, *2460.* On *Juglans regia* L. Austin, *366;* Falfurrias, *2461.*

On the sycamore, definite, irregular, circular or angular spots, dark-brown or purple, and 1–3 mm. in diameter are produced on the upper surface of the living leaves. They frequently show a brown center and the under surface of the spot is brown throughout with a darker brown border. The spots frequently become confluent and produce dirty-brown extended areas. The spots may be very numerous and in nurseries much defoliation results.

On the walnut, this fungus produces subcircular spots 1 mm. in diameter, dark-brown with a darker border on the upper surface and uniformly brown on the under surface. The spots may be few in number or they may be so numerous as to almost completely cover the leaf. It is very severe in some cases and causes much defoliation.

Phleospora adusta

Areis initio marginalis dein effusis, irregularibus, brunneis, folium totum arescentibus adurentibusque; pycnidiis hypophyllis, sparsis, 30–50 μ diam.; sporulis cylindraceis, 1–3-septatis, hyalinis, 18–36 $\times$ 3–3.5 μ.

On living leaves of *Clematis Drummondii* T. & G. New Braunfels, *1699;* Austin, *1726* (*type*); Llano, *1734;* Beeville,

1833; Sabinal, *1976;* Hondo, *1998;* Bastrop, *2021;* Seguin, *2303;* Georgetown, *2390;* Gonzales, *2654;* Kennedy, *2825*.

This leaf blight is very general and very severe. The foliage comes to have large, irregular, brown areas, generally beginning on the leaf tips. The entire leaf becomes dry, brown, and more or less curled in the advanced stages of the disease.

Phyllosticta biformis

Maculis orbicularibus, 2–5 mm. lat., griseis, atro-marginis; pycnidiis in foliis globosis ac in fructibus lenticularibus ostiolatis, 150 μ diam. Sporulis copiosis, granuloso farctis, hyalinis, 6–9 μ.

On *Diospyros texana* Scheele. Llano, *1789;* Austin, *1548, 2896* (*type*).

The Mexican persimmon is affected by this fungus, which produces black pycnidia in clusters upon the upper surface of the leaves. At first they are surrounded by the green tissue but later a dark-margined spot 2–5 mm. in diameter is formed, which is grayish, with the black pycnidia distinctly visible. The pycnidia show on the fruit as minute pustules on slightly sunken spots, but are not very evident on account of the dark color of the fruit.

The pycnidia on the leaves are globose, ostiolate, and produce an abundance of hyaline, densely granular spores; the pycnidia on the fruit are much more flattened, and are covered by the very thick epidermal wall, but contain spores similar to those on the leaf except that they are dilutely brown in color.

Phyllosticta bumeliifolia

Maculis solitariis saepe confluentibus definitis, pallide brunneis, inferne pallidioribus, 3–6 mm. diam.; pycnidiis innatis, epiphyllis, nigris, 125–150 μ; sporulis globosis, granulosis, guttulatis, 9–15 μ diam.

On *Bumelia lanuginosa* Pers. Austin, *1549* (*type*), *3032*.

This fungus causes the formation of pale-brown spots on the living leaves. These spots vary in diameter from 3–6 mm. when circular or subcircular, but often the areas have fused so that much larger irregular spots are produced. The color is less

intense on the lower surface. Numerous black pycnidia open to the upper surface. In severe cases half of the leaf tissue may be involved.

Phyllosticta congesta

Maculis minutis, .5–.8 mm. diam., brunneis numerosis, venis limitatis; pycnidiis solitaris in quaque area, 50–125 μ diam.; sporulis globulosis vel leniter elongatis, hyalinis, 6–9 μ.

On *Prunus* sp. Boerne, *1554* (*type*).

On the upper surface of the leaf are very numerous brown areolae bounded by the veins of the leaf. The lower surface may not be discolored. These minute spots fuse, and each contains at its center a single black pycnidium. The pycnidia contain globular or slightly oval, clear spores.

Phyllosticta Verbesinae

Maculis numerosis, griseis, suborbicularibus zona atrofusca cinctis, 1–3 mm. diam.; pycnidiis epiphyllis, 36–45 μ; sporulis oblongis vel ellipticis 4–6 $\times$ 2.5–3 μ.

On *Verbesina texana* Buckl. Seguin, *2310* (*type*).

This fungus produces gray or whitish subcircular spots, 1–3 mm. in diameter, surrounded by an indefinite darker zone which fades out into the green tissue.

Septoria marginata

Maculis marginalis, effusis, dilute brunneis v. stramineis; peritheciis numerosis, amphigenis, brunneis vel nigris, 87–140 μ; poro leniter pertusis, sporulis hyalinis, rectis saepe curvulis, septatis, 40–60 $\times$ 2.5–3 μ.

On *Rulac texana* (Pax.) Small. Beeville, *1859;* Lockhart, *2060;* San Marcos, *2113* (*type*); Luling, *2279;* Seguin, *2286*.

The tips and margins of the leaves are killed, the dead areas being brick-red, light-brown, or straw-colored, or nearly gray in some cases, and confined to a narrow zone at the leaf tip or margin or extending back until the whole leaflet is involved. The advancing edge of the affected area is bordered by a narrow zone of yellow. The disease results in a considerable amount of defoliation with the appearance of having suffered from drought.

The spore measurements are identical in size with *Cylindro-*

sporium Negundinis Ell. & Ev., and the fungus was first referred to this species by the writers, since the extrusion of the spores from the pycnidia simulated acervuli in external appearance. It is possible that the two are identical.

Septoria Jatrophae

Maculis variis, 1–5 mm. latis, orbicularibus, interdum irregularibus, primo atro-brunneis, margine atro circumdatis, demum centro fulvescentibus vel saepe griseolis, confluentibus, partem majorem foliorum arescentibus; pycnidiis omnino immersis, brunneis, 120–150 μ; sporulis bacillaribus v. leniter clavatis, septatis hyalinis, 40–50 $\times$ 3 μ.

On *Jatropha stimulosa* Michx. Austin, *2429* (*type*).

The species causes the formation of very characteristic, brown, circular areas on the leaves. The spots vary in size from 1–5 mm., and are frequently somewhat irregular in outline. At first, they are dark-brown with a darker, almost black border; later, the centers become tan and sometimes gray but always have a definite dark margin. The spots are frequently so abundant that they fuse, causing the drying of large portions of the leaf.

Septoria pertusa

Amphigenis; maculis magnis, 1–2 cm., indefinitis, brunneolis, fulvo-marginatis, dein margine pallescentibus, confluentibus; perithеciis innatis, fuscis, ostiolo amplo pertusis; sporulis hyalinis, rectis vel leniter curvulis, leniter clavatis, guttulatis, 60–75 $\times$ 3 μ.

On *Sorghum halapense* L. Luling, *2270;* Flatonia, *2722* (*type*).

The diseased areas are elongated parallel to the veins and 1–2 cm. in length, without a definite margin. The brownish center is surrounded by a yellow zone which pales out into the green. These areas become confluent, so that entire leaves may become dry and yellowish-brown in color. The flask-shaped pycnidia are very abundant on both surfaces and protrude by a short papilla. The conidia are extruded so abundantly as to make a white coating.

Stagonospora gigantea

Areis marginalis plerumque apice foliorum arescentibus, griseolis, zonatis; pycnidiis initio subcutaneis, dein erumpentibus,

atris, 500–600 μ diam.; conidiis magnis, hyalinis, dense granulosis, interdum guttulatis, cylindraceis v. leniter clavatis, 3-septatis, 72–115 $\times$ 13–15 μ.

On living leaves of *Agave Americana* L. Austin, *1283* (*type*); San Antonio, *1377;* Boerne, *1648*.

The blight begins at the tips or margins of the leaves and advances toward the base. The diseased tissue becomes dry, gray, and zonate, marking the periodic growth of the fungus. The pycnidia are on both leaf surfaces, covered at first and at length protruding. Our species differs from *S. macrospora* (Dur. & Mont.) Sacc. in having much larger spores and also larger pycnidia. This disease has been very serious, blighting the plants in all the localities where it was observed.

Colletotrichum caulicolum

Acervulis sparsis, nigris, lenticularibus, 150–250 μ. Setis copiosis, brunneis, septatis, utrimque rotundatis vel superne acutis, 60–120 $\times$ 3.5–4 μ; basidiis 30–60 μ, cylindraceis, hyalinis, plerumque 1–2-septatis; conidiis falcatis, hyalinis, granulosis, 18–30 $\times$ 3.5–4 μ.

On living stems of *Phaseolus vulgaris* L. Uvalde, *1963* (*type*).

A destructive disease of the Kentucky Wonder bean, observed in a single locality, was found to be due to this fungus. A superficial examination of the affected field showed a considerable number of plants which were completely dead, others were dying, while still others that were less affected exhibited more or less chlorosis of the foliage. An examination of the root system showed it to be in normal condition, while the only deviation from the normal in the foliage was the marked chlorosis.

An examination of the stems showed that brown, depressed cankers were present an inch or more above the ground level. The cankers were longitudinally elongated (2–4 cm.), more or less irregular, rough and somewhat fissured or open. On the chlorotic plants the canker occupied one side of the stem, on the plants that were dying the stem was nearly girdled, and on all dead plants examined the canker had completely encircled the stem.

The acervuli do not occur on the young cankers, but nearly mature or complete cankers show a few which are visible to the naked eye as small black specks, while they become much more abundant on the stems of plants which have been dead for a few days.

Colletotrichum griseum

Areis initio indefinite marginatis, flavidis dein definitis, margine brunneo elevato, centro griseis, 8–10 mm. latis; acervulis zonatis vel sparsis, primo tectis, globulosis vel lenticularibus, 250 μ diam.; setis numerosis, brunneis, cylindraceis, saepe superne attenuatis, 40–60 $\times$ 5 μ; conidiis rectis vel leniter curvulis, granulosis, guttulatis, hyalinis, raro inaequaliter 1-septatis, 14–17 $\times$ 4 μ.

On leaves and branches of *Euonymus japonicus* Thunb. Austin, *1280* (*type*); San Antonio, *1404;* Lockhart, *2110;* Georgetown, *2363*, *2375*, *2376*.

This is one of the most common diseases of the Chinese box for this region. It forms on the leaves indefinite-margined, yellow blotches 1–4 mm. in diameter. These increase in size until the diseased areas are sometimes 8–10 mm. across, and a definite brown elevated border is formed, when the center of the spot becomes gray. Scattered over this gray area are numerous black acervuli either zonate or more or less scattered, usually concentrically arranged. Often the spots are marginal or the disease may even apparently work back from the tip of the leaf. The twigs and larger branches are also affected, resulting in the formation of gray cankers 1–8 mm. in diameter. These gray patches drop away, leaving the brown cankered area exposed.

Cylindrosporium defoliatum

Areis irregularibus, griseolis, initio 1–2 cm. diam., confluentibus, saepe partem majorem foliorum occupantibus; acervulis amphigenis, plerumque epiphyllis; conidiis cylindraceis, hyalinis, 30–42 $\times$ 3–3.5 μ, 3–5-septatis.

On *Celtis mississippiensis* Bosc. New Braunfels, *1673;* Austin, *1728*, *1905* (*type*); Beeville, *1855;* Elgin, *1890;* Bastrop, *2049;* Lockhart, *2073;* San Marcos, *2099;* Cotulla, *2180;* Luling, *2256;* Seguin, *2317;* Georgetown, *2377;* Victoria, *2509;* Cuero, *2578;* Stockdale, *2615;* Gonzales, *2689;* Flatonia, *2709;* Yoakum, *2771*. On *Celtis reticulata* Sarg. Sabinal, *1975*.

The common hackberry of this region, *Celtis mississippiensis*, is quite generally affected with a serious leaf blight which first produces irregular gray blotches 1–2 cm. in diameter. These blotches sometimes coalesce and involve a large part of the leaf. In early stages of the disease the adjacent tissue may remain green, but later a considerable amount of yellowing is produced and the affected leaves fall from the tree. The acervuli are amphigenous, but more abundant upon the upper surface. The spores are extruded in masses and accumulate on the surface of the leaf where they are visible as minute white tufts. This species is clearly distinct from *Cylindrosporium Celtidis* Earle, which has been described as forming small spots on *Celtis mississippiensis* in Alabama.

Cylindrosporium griseum

Maculis variis, numerosis, orbicularibus vel leniter angulatis, 1–5 mm. latis plerumque 1–2 mm., saepe confluentibus; acervulis amphigenis, in venis, orbicularibus vel elongatis, maturitate atris; conidiis cylindraceis, leniter curvulis, hyalinis, 7–9-septatis, $90–135 \times 3–4.5\,\mu$.

On leaves of *Sapindus marginatus* Willd. Kerrville, *1588;* Llano, *1757* (*type*); Bastrop, *2026;* San Marcos, *2098*.

Very numerous grayish or whitish, circular or slightly angular spots are produced on both surfaces of the leaflets and the rachis; and show more prominent veins owing to the shrinking of the tissue. These spots may become confluent and cause extended dead areas. The acervuli are amphigenous, more abundant on the upper surface, and are located immediately over the prominent veins. They may be nearly circular in outline or much elongated along the veins, pale when young and becoming darker with age.

Cylindrosporium Lippiae

Maculis 2–3 mm. diam., centro griseolis, margine angusto brunneo cinctis; acervulis amphigenis, plerumque epiphyllis, 30–100 μ diam.; conidiis subcylindraceis, hyalinis, continuis vel 1–3-septatis, $24–54 \times 3\,\mu$.

On leaves of *Lippia ligustrina* Britton. Llano, *1756* (*type*).

This fungus produces three or four circular spots on each leaf.

The spots have gray centers, with narrow brown borders edged with a tinge of yellow, and show in the center numerous white conidial tufts.

Cylindrosporium solitarium

Maculis numerosis, minutis, .5–1 mm. diam., initio atro-brunneis, deinde centro plus minusve pallescentibus vel albescentibus ac margine angusto viride cinctis; acervulis hypophyllis, initio innatis 1–2 in quaque area; conidiis plerumque leniter curvulis, cylindraceis, hyalinis, 3–6-septatis, 45–60 × 3–4 μ.

On living leaves of *Robinia pseudacacia* L. Austin, *459, 1909* (*type*); Georgetown, *2334*.

This disease is characterized by the presence of minute brown spots upon the leaflets. In the early stages of the disease the leaflets have their normal green color and the spots show as circular areas, which have a pale-brown center and a narrow darker brown border surrounded by a faint zone of chlorotic tissue. As the disease progresses the entire leaflet turns to a bright-yellow color, with the exception of narrow zones of pale-green which persist around the circumference of the brown spots. In this stage the spots show an outer zone of green, a middle zone of dark-brown, and a central area of light-brown or grayish tissue. Affected leaflets may show from one to forty spots and these are generally isolated, although they may be somewhat clustered. The leaflets fall soon after they assume the yellow color, and sometimes even before the complete chlorotic stage has has been reached, and in many cases considerable defoliation results. The disease was observed during the season of 1908 in a much more severe form than during the past season. In all cases it was observed only on nursery trees which were badly crowded. Each spot shows one and occasionally two acervuli, which occupy the middle of the light-brown central area. A straight or curved mass of spores may be seen extruded from the acervulus, which is immersed in the tissue of the under surface.

Cylindrosporium tenuisporum

Plerumque hypophyllis, saepe epiphyllis; maculis leniter irregularibus, superne brunneis, centro griseolis, margine angusto flavido cinctis, inferne aequaliter brunneis, 2–10 mm. diam.;

acervulis nigris, minutis; conidiis cylindraceis, hyalinis, continuis, rectis v. leniter curvulis, 15–24 × .75–1 μ.

On leaves of *Ulmus crassifolia* Nutt. Austin, *307* (*type*).

The small-leaved elm is affected by a leaf spot which shows as brown, circular or slightly irregular areas, generally with a gray center and a narrow yellow border. The under surfaces of the spots are more uniformly brown and show minute black specks, the acervuli of the fungus. In a few cases the acervuli may be found on the upper surface.

Cercospora adusta

Areis magnis, marginalis, atro-brunneis; maculis veteribus adustis, juvenibus dilute brunneis, margine flavida late cinctis; conidiophoris amphigenis, caespitosis, brunneis, septatis, 100–150 × 4–5 μ; conidiis dense granulosis, subhyalinis, pluriseptatis, 85–160 × 3–4 μ.

On leaves of *Ligustrum californicum* Hort. Falfurrias, *2471* (*type*); Floresville, *2851*.

This species forms dark-brown areas involving large spots frequently extending from the tip downward or from the margin inward. Rarely are the spots removed from the margin. The older diseased parts become very dark and the newer brown, with a gradual shading out into the chlorotic tissue.

Cercospora atricincta

Maculis irregularibus, angulatis, centro griseis, brunneo marginatis, 1–2 mm. diam., interdum 4 mm. diam., late purpureo marginatis; conidiophoris amphigenis, caespitulis minutis, septatis, 45–70 × 3.5–4.5 μ; conidiis dilute brunneis, pluriseptatis, clavatis, 100–200 × 4–4.5 μ.

On leaves of *Zinnia* sp. San Antonio, *1381*, *1660;* Victoria, *2506* (*type*).

This disease, rather common in gardens, is characterized by the presence of irregular, angular, gray spots with a brown border. When the spots are abundant this border is narrow and the spots are small, 1–2 mm. in diameter. When they are few they may be 4 mm. in diameter, with a broad marginal zone of purple or dark-brown.

Cercospora aurantia

Maculis atro-brunneis, flavidis cinctis, 6–10 mm. lato; hyphis fertilibus hypophyllis, brunneis, septatis, denticulatis, vel nodulosis; conidiis dilute brunneis, clavatis, pluriseptatis, $75–135 \times 4–5\ \mu$.

On *Citrus Aurantium* L. Falfurrias, *2446* (*type*).

This fungus forms large spots, 6–10 mm. in diameter, and suborbicular except when they are marginal. They are dark-brown in color with a lighter brown center and surrounded by a region of yellow which fades out into the green of the leaf. The conidiophores, formed on the lower surface in small groups, show plainly the points of attachment of the conidia.

Cercospora Capsici

Maculis rotundatis, 1–7 mm. diam., primo brunneis deinde pallescentibus brunneis, zona flavida cinctis; conidiophoris amphigenis, brunneis, 10–15-fasciculatis, septatis, $30–60 \times 4.5–5.5\ \mu$. Conidiis plerumque rectis, clavatis, dilute brunneis, septatis paucis, $75–125 \times 4–5\ \mu$.

On *Capsicum annuum* L. Cuero, *2592* (*type*).

Leaves infested with this fungus form spots 1–7 mm. in diameter, mostly circular or subcircular. The spots are raised on the upper surface, brown at first, later becoming grayish-brown. They are margined by a very definite darker zone outside of which is a more or less extended halo of yellow. Where the spots are abundant the leaves become chlorotic, wilt and fall.

Cercospora Chrysanthemi

Areis superne elevatis, inferne depressis, 2–10 mm. lat., margine elevata, subcircularibus vel irregularibus, brunneis maturitate griseolis. Conidiophoris amphigenis, dense aggregatis, septatis, $40–75 \times 4\ \mu$; conidiis clavatis, pluriseptatis, subhyalinis, $40–120 \times 4\ \mu$.

On *Chrysanthemum* sp. San Antonio, *1659* (*type*).

The diseased areas are raised above and sunken below and vary much in size. They have very definite elevated borders, are subcircular or irregular in outline, and brown in color, becoming gray with age. When the spots are abundant, the leaf becomes brown between the diseased areas.

Cercospora Crataegi

Maculis magnis, atro-brunneis irregularibus, inferne pallidioribus, 5–10 mm. latis; confluentibus quandoque numerosis; conidiophoris dense fasciculatis, continuis, brunneis, $24–30 \times 5–6\ \mu$; conidiis clavatis, rectis curvulisve, pluriseptatis, guttulatis, $120–180 \times 5–7\ \mu$.

On leaves of *Crataegus* sp. Gonzales, *2697* (*type*).

This fungus causes the formation of large dark-brown, irregular areas from 5–10 mm. or more in diameter. The spots are darker above than below and when as many as 20–25 in number are confluent, involving large areas with chlorotic tissue surrounding them. The upper surface is broken by the numerous brown tufts of conidiophores and conidia.

Cercospora Elaeagni

Amphigenis; maculis orbicularibus v. suborbicularibus, 1–2 mm. latis, centro griseolis vel brunneolis, margine brunneo definite cinctis, saepe totum folium flavidis: conidiophoris fasciculatis, plerumque epiphyllis, atro-brunneis, $40 \times 3.5–4\ \mu$; conidiis septatis, subhyalinis, clavatis, rectis curvulisve, $28–150 \times 2.5–4\ \mu$.

On living leaves of *Elaeagnus* sp. Floresville, *2861* (*type*).

When this disease is present the leaves show on the upper surface an abundance of circular or subcircular spots 1–2 mm. in diameter, with a definite brown border and a whitish or brown center. The spots are inconspicuous on the under surface on account of the dense silvery tomentum. There is generally some yellowing beyond the spots and in many cases a pronounced yellowing of the whole leaf.

Cercospora Fici

Maculis magnis, angulatis, superne brunneis, atro-marginalis, inferne aequaliter flavido-brunneis, 1.5–10 mm. diam. saepe confluentibus; conidiophoris dense fasciculatis, epiphyllis, dilute brunneis, $24 \times 4\ \mu$; conidiis clavatis, brunneis, pluriseptatis, $60–180 \times 3–4.5\ \mu$.

On a variety of *Ficus Carica*. Victoria, *2501;* Cuero, *2593* (*type*); Gonzales, *2674;* Flatonia, *2711;* Hallettsville, *2784*.

This disease appears late in the summer, forming on the leaves large angular or irregular spots, which are dirty-brown above

with a darker border, and uniformly yellowish-brown below. The disease was very abundant in several localities, involving half of the leaf surface and causing the leaves to fall.

Cercospora floricola

Areis indefinitis, effusis, griseolis vel brunneolis, maturitate atrofuscis, perianthium partem majorem v. totum occupantibus saepe scapum insidientibus; conidiophoris dense fasciculatis brevibus, brunneis, continuis, $30–45 \times 5–6\ \mu$; conidiis plerumque rectis, cylindraceis v. leniter clavatis, hyalinis vel pallide brunneis, 1–5-septatis, $18–69 \times 5–5.5\ \mu$.

On *Yucca rupicola* Scheele. Austin, *1438* (*type*).

In this disease, elongated grayish or brownish patches are produced which become darker with age and spread over the main scape, the flower pedicels, and the outer divisions of the perianth. The creamy-white outer perianth segments may be completely covered with the conidial tufts, which cause them to be turned nearly black and to shrivel more or less. The fungus may spread over the whole segment from the tip downwards. The perianth divisions may be attacked before the flower opens and the flower bud completely blighted or the flower may expand to full size and open in the normal way but blight completely a little later. In the locality where the disease was prevalent fruit formation did not take place.

Cercospora fulvella

Epiphyllis interdum amphigenis; maculis irregularibus, flavido-brunneis, 5–10 mm. diam., confluentibus, areas magnas insidientibus necantibusque, inferne pallidioribus; conidiophoris aggregatis, septatis, $40–150 \times 4–5\ \mu$; conidiis clavatis, rectis, 3–4-septatis, pallide brunneis, $40–60 \times 4–5\ \mu$.

On leaves of *Verbesina texana* Buckl. Austin, *406* (*type*).

This disease is characterized by the presence of irregular yellowish-brown areas, which sometimes become confluent, causing the death of larger areas. The color is more dilute and the spots are less definite on the under surface of the leaf.

Cercospora lanuginosa

Epiphylla; maculis foliorum primo indefinite marginatis, atrobrunneis, deinde 1–3 mm. lata, definita, margine brunnea cinctis,

centro griseolis; conidiophoris dense aggregatis, 15 μ longis; conidiis cylindraceis, leniter clavatis, fumagineis, 3–4-septatis, 45–54 $\times$ 4–5 μ.

On *Bumelia lanuginosa* Pers. Luling, *2222* (*type*); Flatonia, *2742*.

This disease first appears as indefinite margined, dark-brown spots on the upper surface of the living leaf. At length these areas become irregular in outline with a definite brown margin and a grayish center. Owing to the woolly coating on the lower surface, the leaf spots show through only faintly as brown areas. Scattered over the upper surface of the spot are very dense clusters of conidiophores.

Cercospora Lythracearum

Amphigenis; maculis subcircularibus, indefinite marginatis, superne atro-brunneis, zona flava limitatis, inferne flavo-brunneis, 2–8 mm. diam.; conidiophoris dense aggregatis, pallide brunneis, plerumque epiphyllis, continuis, 15–30 $\times$ 3 μ; conidiis clavatis vel subcylindraceis, subhyalinis, 30–56 $\times$ 3–3.5 μ, 2–5-septatis.

On *Lagerstroemia indica* L. Austin, *466* (*type*). On *Punica Granatum* L. Beeville, *1829;* Victoria, *2510, 2515;* Cuero, *2589;* Flatonia, *2738;* Falfurrias, *2472*.

On the crape myrtle, circular to subcircular, indefinite margined areas appear on the foliage. These spots are uniformly yellowish-brown below and dark-brown above, with a limiting zone of yellow tissue paling out into the green. On the pomegranate, this fungus produces angular, more or less rounded brown spots with an indefinite margin below.

Cercospora macromaculans

Amphigenis; areis magnis 1 cm. lat., brunneis arescentibus, plus minusve irregularibus, centro griseolis, saepe zonatis; conidiophoris dense aggregatis, septatis, atro-brunneis, 60–75 $\times$ 6 μ; conidiis clavatis apice gradatim attenuatis, septatis, subhyalinis, 70–187 $\times$ 2.8–3 μ.

On *Syringa* sp. Kerrville, *1603* (*type*); Austin, *463, 1910*.

This blight is characterized by the presence of large brown, dead patches, which are more or less irregular and either central or marginal. The center of the spots is frequently gray, and

sometimes an evident zonation is exhibited due to the concentric arrangement of the dark conidial tufts. This blight causes the death of many leaves and much defoliation.

Cercospora Malachrae

Maculis orbicularibus vel suborbicularibus 1–4 mm. diam., centro flavido-griseis, purpureo-marginatis; conidiophoris caespitosis, amphigenis nodulosis, apice pallidioribus, $90–120 \times 4–5\ \mu$; conidiis clavatis, hyalinis, apice attenuatis, $100–210 \times 4–5\ \mu$, pluriseptatis.

On *Malachra capitata* L. Victoria, *2347* (*type*).

Circular or subcircular spots are produced on the living leaves. They have a yellowish-gray center, on which the conidial tufts are evident, surrounded by a dark-purple border. The spots are slightly less pronounced upon the under surface.

The conidiophores are amphigenous, in fascicles of a few to a dozen, brown, with slightly paler tips, nodose extremities, and several septa. This species of *Cercospora* seems to be distinct from the many described for different species of the Mallow family. It agrees most nearly with *C. polymorpha* Bubank.

Cercospora obscura

Maculis rotundatis, griseis, zona dilute brunnea circumdatis, 1–2 mm. latis; conidiophoris epiphyllis, fasciculatis 4–7, brunneis, apice hyalinis $50–80 \times 4–5\ \mu$; conidiis rectis curvulisve, cylindraceis, 3–4-septatis, dilute brunneis, $40–74 \times 3–4\ \mu$.

On living leaves of *Cynara Scolymus* L. Beeville, *1861* (*type*).

The presence of this disease is made manifest by circular, gray spots, which appear on the upper surface of the leaf in great numbers. Each spot has a faint brown border with the tufts of conidiophores on the upper surface. Since the lower surface of the leaf is covered by a silvery tomentum, the spots appear as slightly darker areas.

Cercospora perniciosa

Maculis rufo-brunneis, atro-marginalis saepe zonatis, inferne pallidioribus, 3 cm. diam., confluentibus, foliis omnibus occupantibus; conidiophoris dense fasciculatis, hyalinis vel dilute brunneis, $40–50 \times 3–4\ \mu$; conidiis clavatis, guttulatis, obscuro septatis, $40–105 \times 3–4\ \mu$.

On *Cephalanthus occidentalis* L. Victoria, *2539* (*type*); Austin, *2869*.

When this disease is present the entire foliage of the tree is seriously affected. Isolated spots are about 1 cm. in diameter, and reddish-brown with a darker border. The spots often have narrow rings of this darker brown tissue, rendering them zonate. Most commonly these spots are irregular in outline, as the diseased areas have fused, causing a large part of the leaf to become dry. The lower surface of the spots is much more dilutely colored; on the upper surface, the profusion of conidiophores and conidia render the spots grayish. Where the disease has been observed the trees are almost entirely deprived of their leaves.

Cercospora Prosopidis

Maculis irregularibus, angularibus, brunneis, margine angusto atro-brunneo limitatis, initio saepe folii margine insidientibus demum totum folium occupantibus necantibusque; conidiophoris amphigenis, dense aggregatis, aequaliter brunneis, continuis, $18–30 \times 3–4\,\mu$; conidiis rectis, brunneolis, cylindraceis v. leniter clavatis, 1-pluriseptatis, $20–70 \times 4–5\,\mu$.

On *Prosopis glandulosa* Torr. Uvalde, *1959* (*type*); Luling, *2264;* Gonzales, *2663;* Falfurrias, *2468;* Kennedy, *2824;* Floresville, *2847*.

This disease is characterized by the presence of irregular, angular, brown patches which occupy one side of the midrib of the leaflets or extend across the whole leaflet, and are generally bounded by a narrow brown border. The spots may be either terminal or removed from the apex of the leaflet, and frequently advance until the whole leaflet is killed or drops from the tree. In some cases it is very abundant and causes considerable defoliation. Its greatest development may be found in dense mesquite thickets.

Cercospora xanthicola

Maculis numerosis, interdum 400–600 in quoque folio .5–2 mm. lat. (plerumque 1 mm.), centro cini-griseolis vel brunneolis, margine atro-fusco angusto limitatis; conidiophoris amphigenis, 3–8-fasciculatis, apice hyalinis, nodulosis, continuis, raro septatis, $60–100 \times 3–3.5\,\mu$; conidiis tenuisimis, clavatis, gradatim attenuatis, apice obscure septatis, subhyalinis, $105–135 \times 3\,\mu$ saepe $245\,\mu$ longis.

On *Xanthium* sp. Luling, *2236;* Georgetown, *2383* (*type*); Nursery, *2567;* Cuero, *2588;* Gonzales, *2705;* Yoakum, *2755;* Hallettsville, *2790;* Kennedy, *2836;* Austin, *2871.*

This fungus produces upon the leaves numerous circular or subcircular spots with dirty-gray or brownish centers surrounded by a narrow darker border. The number of infections on a single leaf may reach as high as 400 to 600, in which case the leaf shows more or less chlorosis, but frequently the spots are less numerous and the leaf shows little or no deviation from the normal color.

Clasterosporium diffusum

Maculis indefinite marginatis, amphigenis; irregularibus, aequaliter brunneis, 5–10 mm. diam.; hyphis effusis, prostratis, saepe laxe gregariis atque erectis; conidiis curvulis, clavatis, pluriseptatis, brunneis, $45–135 \times 4–5\,\mu$.

On *Hicoria pecan* (Marsh) Britton. Victoria, *2536;* Gonzales, *2695* (*type*); Yoakum, *2770;* Hallettsville, *2783.*

This fungus produces circular or irregular, indefinite margined, brown spots, which are uniformly brown on both surfaces of the leaflets. Dark-brown hyphae run throughout the dead tissue or creep over either surface of the affected area, or are sometimes aggregated to produce clusters of erect conidiophores.

Helminthosporium giganteum

Caespitulis sparsis, epiphyllis, maculis stramineis, $.5–1 \times 1–4$ mm., confluentibus; hyphis fertilibus atro-brunneis, plurispetatis, base leniter inflatis, $200–400 \times 9–12\,\mu$; conidiis cylindraceis 5-septatis, pallide brunneis, granuloso farctis, $300–315 \times 15–21\,\mu$.

On *Capriola Dactylon* (L.) Kuntze. Falfurrias, *2440* (*type*).

This disease is charactertized by the presence of numerous yellowish or pale straw-colored spots, longitudinally elongated and with a narrow brown border. The spots are generally absent from the leaf sheath, and when numerous they may become confluent on the lamina and thus cause somewhat extended dead areas.

Ramularia hedericola

Maculis magnis, irregularibus, superne griseolo-brunneis, inferne aequaliter brunneolis, margine elevato; hyphis epiphyllis, septatis, $60–120 \times 4\,\mu$; conidiis hyalinis, $9–15 \times 2.5\,\mu$.

On *Hedera Helix* L. San Marcos, *2130* (*type*).

Large irregular spots, grayish-brown above and brown below, appear on the living leaves. The margin of the diseased area is elevated, with the conidial tufts on the upper surface.

Ramularia Momordicae

Maculis initio indefinitis, flavidis, tum demum suborbicularibus, superne flavido-brunneis, plus minusve zonatis, 1–10 mm. diam., inferne margine elevato, atro-brunneis, saepe numerosis, confluentibus, folium totum arescentibus; hyphis caespitosis, brunneis, 30–45 × 4–5 μ; conidiis cylindraceis, hyalinis, 1–5-septatis, 42–65 × 4–5 μ.

On *Momordica balsamina* L. Falfurrias, *2482* (*type*).

In the early stages of this disease the leaves show irregular blotches of yellow, and as it advances there are formed, on the upper side of the leaf, circular to subcircular yellowish-brown areas with a more or less evident zonation. The spots are often so numerous as to be confluent, causing the leaves to curl and become dry. A large amount of defoliation results.

Exosporium concentricum

Areis subcircularibus, .5–2 cm. diam.; zonatis, brunneis v. flavidis interdum griseis, zona angusta brunnea cinctis; sporodochiis concentricatis v. sparsis, initio innatis; conidiis clavato-cylindraceis, septatis, subhyalinis, rectis vel leniter curvulis, 25–45 × 2.5–3 μ.

On *Euonymus japonicus* Thunb. San Marcos, *2129;* Georgetown, *2375;* Austin, *2867* (*type*).

This fungus produces on the leaves of the Chinese box circular, zoned areas. The affected leaves may show considerable yellowing beyond the diseased areas and in severe cases much defoliation follows. The sporodochia are at first covered and at length protrude, causing that portion of the leaf to become grayish, because the rupture of the epidermis has admitted the air.

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THE AGARICACEAE OF TROPICAL NORTH AMERICA—I

William A. Murrill

This series of articles is based upon original studies of fresh specimens in Cuba, Jamaica, and Mexico, supplemented by large collections obtained in many parts of tropical America by Britton, Earle, Underwood, Shafer, Wilson, Brace, M. E. Peck, Small, Harris, C. L. Smith, Broadway, Williams, Howe, Duss, Wright, Mrs. Britton, Mrs. Earle, Miss Marble, and others.

The collections at Kew, Paris, Berlin, Upsala, Stockholm, and Copenhagen have also been examined with special reference to the gill-fungi of our tropics, and representative specimens have been compared with type material wherever it was found. The difficulty of preserving specimens of these plants, the lack of proper field notes, and the meager and scattered attempts previously made to gain any comprehensive knowledge of our tropical gill-fungi have resulted in much confusion of species and many synonyms.

Certain common and easily preserved species will be found in nearly every collection, often under a new name. Variations in these strong, prevailing types, which easily run together when examined in hundreds of specimens in the field, loom to specific proportions in a herbarium several thousand miles distant. It may be argued that these varieties are as distinct as many good species; but such abundant and widely distributed types are a law unto themselves, transcending geographical and varietal bounds in their exuberance and defying all attempts to segregate them at the present stage of their evolution. Every mycologist is acquainted with such specific types in most groups of fungi, and every one knows that they are hopeless, some of them even crossing generic and family lines!

The region here designated as tropical North America includes Mexico south of Zacatecas, Central America, and all of the islands lying between North America and South America, with

the exception of Trinidad. To these must be added the Bermudas, which, although far north of the recognized boundary are rendered tropical by the Gulf Stream and contain a large percentage of West Indian species.

Our present study does not include species occurring in South America, but it has been necessary to examine them because so many are common to the American tropics. The same is true to a less extent of the oriental tropical species, several of which are common to both hemispheres, owing, possibly, to former connections by means of land now submerged.

The gap between temperate and tropical North America is comparatively wide and abrupt, if we except the border species in Mexico and southern Florida, and the few temperate species occurring in the higher mountains in the tropics, where temperate conditions prevail. The tropical collector misses such conspicuous genera as *Russula, Lactaria, Cantharellus, Hygrophorus, Amanita, Amanitopsis, Tricholoma, Entoloma, Cortinarius, Paxillus,* and *Inocybe,* whose species compose such a large share of the gill-fungi met with in our northern woods, and he must become familiar with several new genera and a great many new species that are peculiarly tropical.

Tribe CHANTERELEAE

This tribe, containing species with plicate hymenium, has been treated in *North American Flora,* volume 9, part 3, the following species being there recorded for tropical America: *Plicatura guadelupensis* (Pat.) Murrill, *Plicatura lateritia* (Berk. & Curt.) Murrill, *Xerotinus martinicensis* (Pat.) Murrill, *Xerotinus Mauryi* (Pat.) Murrill, *Xerotus caribaeus* Fries (doubtful), *Asterophora Clavus* (Schaeff.) Murrill, *Trogia cinerea* Pat., *Chanterel infundibuliformis* (Scop.) Fries, *C. cinnabarinus* Schw., *C. mexicanus* Fries, *Neurophyllum ochraceum* Pat., and *Chlorophyllum viride* (Pat.) Murrill. Since the above was published, the range of a few of these species has been extended by recent explorations, and a change in nomenclature has been found necessary in the two following cases.

Plicatura obliqua (Berk. & Curt.)

Marasmius obliquus Berk. & Curt. Jour. Linn. Soc. **10**: 299. 1868. (Type from Cuba.)

Panus Wrightii Berk. & Curt. Jour. Linn. Soc. **10**: 299. 1868. (Type from Cuba.)

Lentinus verae-crucis Berk. &. Curt. Jour. Linn. Soc. **10**: 303. 1868. (Type from Vera Cruz.)

Xerotus Mauryi Pat. Bull. Soc. Myc. Fr. **14**: 51. *pl. 7. f. 1.* 1898. (Type from Mexico.)

Xerotus guadelupensis Pat. Bull. Soc. Myc. Fr. **15**: 195. 1899. (Type from Guadeloupe.)

Plicatura guadelupensis (Pat.) Murrill, N. Am. Fl. 9: 164. 1910.

Specimens at Kew labeled *Marasmius Emerici* Berk., from the Andaman Islands, resemble this species. Typical specimens at Paris from Brazil, collected by Gaudichaud, are incorrectly named *Xerotus rawakensis* Pers. Recent collections are as follows:

Jamaica, *Earle 581, 428, 429, 432, 225, 447, Murrill 47, 100, 147;* Cuba, *Underwood & Earle 1640;* British Honduras, *M. E. Peck;* New Providence, *E. G. Britton 623, 713, 718.*

Chloroneuron nom. nov.

Chlorophyllum Murrill, N. Am. Fl. 9: 172. 1910. Not *Chlorophyllum* Mass. Kew Bull. 135. 1898.

Chloroneuron viride (Pat.)

Neurophyllum viride Pat. Jour. de Bot. 2: 406. 1888.

Chlorophyllum viride (Pat.) Murrill, N. Am. Fl. 9: 172. 1910.

Excellent specimens from French Guiana and Martinique are to be seen in Patouillard's herbarium, but the species is evidently rare, as no other collections of it are known.

Tribe LACTARIEAE

The members of this tribe are practically confined to temperate regions. Seventy-two species of *Lactaria* are listed for North America by Miss Burlingham, and there are probably nearly as many species of *Russula*. Berkeley records a species of *Lactaria* from Cuba, and Duss a species of *Russula* from Guadeloupe, both

unidentifiable. Our collections contain the following species, determined by Miss Burlingham.

LACTARIA INSULSA Fries, Epicr. Myc. 336. 1838

Collected in a moist virgin forest at 5,000 ft. elevation near Jalapa, Mexico, *W. A. & Edna L. Murrill 127*. Pileus depressed, the surface marked with narrow zones varying in tone, as in New York specimens.

LACTARIA SUBDULCIS (Pers.) Fries, Epicr. Myc. 345. 1838

Collected on dead trunks of tree ferns in the Cockpit Country, Jamaica, at 2,000 ft. elevation, *Murrill & Harris 876, 1021*. It is rather difficult to account for the presence of this temperate species in a locality so different from its usual surroundings.

Russula mexicana Burlingham sp. nov.

Pileus convex to depressed, 6 cm. broad; surface smooth, dry, pale-red, with inseparable pellicle, striate at the margin; context white, 5 mm. thick at the center, promptly and decidedly acrid in taste; lamellae adnate, equal, white when young, becoming pale-yellow at maturity; spores subglobose, echinulate, pale-yellow, 7–8 μ; stipe stout, cylindric, glabrous, roseus, 4×2 cm.

This species is related to *R. paluslris* Peck, described from New York, which differs in its separable pellicle and tardily acrid flesh. The above diagnosis was mainly drawn from the field notes and colored sketch accompanying the specimens.

Type collected near Jalapa, Mexico, on humus under the end of a log in rather open woods, December 12–20, 1910, *W. A. & Edna L. Murrill 160*.

Tribe AGARICEAE

This tribe comprises all the remaining fleshy gill-fungi, or those having the hymenium truly lamellate and the context composed of slender, elongate cells. Earle has recently published in the *Bulletin of the New York Botanical Garden* an exhaustive treatment of the genera of the gill-fungi of North America, with descriptions and keys, to which the student of this group is referred.

In treating the tropical species, I do not consider it necessary to follow the taxonomic sequence strictly, so I shall begin with the old genus *Lentinus,* which contains several very common and conspicuous species, rather than with the groups of small sessile species which naturally precede it.

These conspicuous species of our Tropics, usually regular and centrally stipitate when growing under normal conditions, fall rather easily into three genera, which may be distinguished by means of the following simple key.

Veil present, at least in young stages.	1. LENTODIUM.
Veil absent, even in young stages.	
Lamellae adnate.	2. LENTINULA.
Lamellae decurrent.	3. LENTINUS.

1. LENTODIUM Morgan, Jour. Cinc. Soc. Nat. Hist. **18**: 36. 1895

This genus differs from *Lentinus* in having a veil, which often disappears with age without forming an annulus.

Lentodium squamosum (Huds.)

Agaricus squamosus Huds. Fl. Angl. **2**: 614. 1778. (Based on Schaeff. Fung. Bav. *pl. 29, 30.*)

Agaricus squamosus Schaeff. Fung. Bav. ed. 2. **4**: 15. *pl. 29, 30.* 1800.

Agaricus lepideus Fries, Obs. Myc. **1**: 21. 1815.

Lentinus lepideus Fries, Syst. Orb. Veg. 78. 1825.

This well-known temperate species, so common in Europe and the United States, and so destructive to railway ties and other structural timbers, especially in the southern states, is evidently not well adapted to extreme tropical conditions. No attempts have been made to cite its European synonyms. *Lentinus annulatus* Earle, described from Nevada, differs mainly in its gigantic size. *Lentinus suffrutescens* Fries, collected by Oersted in Costa Rica, is no doubt an aborted sterile form.

Cuba, *Underwood & Earle 1495, Earle 55, Earle & Murrill 575, Van Herman 249, 177;* Jamaica, *Earle, E. G. Britton 1049;* Porto Rico, *Earle 90;* Mexico, *Murrill 80.*

2. LENTINULA Earle, Bull. N. Y. Bot. Gard. **5**: 416. 1909

In this genus, the lamellae are adnate and the context rather thick and firm.

Lentinula detonsa (Fries)

Lentinus detonsus Fries, Nova Symb. 38. 1851. (Type from Costa Rica.)

Lentinus cubensis Berk. & Curt. Jour. Linn. Soc. **10**: 302. 1868. (Type from Cuba.)

Lentinus proximus Berk. & Curt. Jour. Linn. Soc. **10**: 302. 1868. (Type from Cuba.)

Lentinula cubensis Earle, Bull. N. Y. Bot. Gard. **5**: 417. 1909.

This species occurs on dead wood in many parts of the West Indies, and also in Costa Rica and Louisiana. The gills are separated from the stipe in all the specimens I have seen, as though torn away by contraction on drying.

Cuba, *Wright;* Guadeloupe, *Duss;* Martinique, *Duss;* St. Vincent, *Elliott;* Porto Rico, *E. G. Britton & D. W. Marble 1213.*

3. LENTINUS Fries, Syst. Orb. Veg. 77. 1825

Panus Fries, Epicr. Myc. 396. 1838.

Pocillaria (P. Browne) O. Kuntze, Rev. Gen. **2**: 865. 1891.

The fact that the type of the genus *Lentinus* (*L. tuber-regium* Fries) produces its sporophores from a tuberous sclerotium would hardly seem sufficient to segregate this genus from *Pocillaria;* especially in view of the fact that the mycelium of some species of *Pocillaria* tends to assume the sclerotial form when growing in decayed wood mixed with earth, and that this form is found in several widely different groups of fungi, apparently for the purpose of rest and protection until sufficient food can be stored up to insure the production of sporophores.

A few of the tropical American species of this genus have been recently figured in Romell's report of 1901 on the fungi of the Regnell Expedition, and in Earle's paper on Cuban fungi published in the first annual report of the Cuban Experiment Station. Most of them, however, keep well in the dried state, and it is usually possible to restore them to their original form by placing them for a short time in a moist chamber.

1. LENTINUS STRIGOSUS (Schw.) Fries, Syst. Orb. Veg. 77. 1825

Agaricus crinitus Schw. Schr. Nat. Ges. Leipzig **1**: 89. 1822. Not *Agaricus crinitus* L. 1753. (Type from Georgia.)

Agaricus strigosus Schw. Schr. Nat. Ges. Leipzig **1**: 89. 1822. (Type from North Carolina.)

Lentinus Lecomtei Fries, Syst. Orb. Veg. 77. 1825. (Based on *A. crinitus* Schw.)

Panus rudis Fries, Epicr. 398. 1838. (Based on *A. hirtus* Secr. 1833.)

Lentinus sparsibarbis Berk. & Curt. Jour. Linn. Soc. **10**: 301. 1868. (Type from Cuba.)

Lentinus substrigosus P. Henn. & Shirai, Engl. Jahrb. **28**: 270. 1900. (Type from Japan.)

This cosmopolitan species is very common on old logs and stumps from Maine to Florida and Texas and throughout tropical America. In Europe, as well as in America, it has received many names, several of which are not listed above. *Agaricus cyathiformis* Schaeff. is by many considered a synonym. *L. chaetophorus* Lév., described from Java, is closely related.

2. **Lentinus hirtus** (Fries)

Agaricus (*Pleurotus*) *hirtus* Fries, Linnaea **5**: 508. 1830. (Type from Brazil.)

Panus hirtus Fries, Epicr. Myc. 398. 1838.

Lentinus submembranaceus Berk. Lond. Jour. Bot. **2**: 634. 1843. (Type from Brazil.)

Agaricus hemispilus Lév. Ann. Sc. Nat. III. **2**: 168. 1844. (Type from Guadeloupe.)

Lentinus patulus Lév. Ann. Sc. Nat. III. **5**: 119. 1846. (Type from Guadeloupe.)

Lentinus Tanghiniae Lév. Ann. Sc. Nat. III. **5**: 120. 1846. (Type from Madagascar.)

Lentinus striatulus Lév. Ann. Sc. Nat. III. **5**: 120. 1846. (Type from French Guiana.)

Lentinus Fockei Miq. Fijd. Wetensch. Amsterdam 188. 1852. (Type from Surinam.)

Lentinus calvescens Berk. Hook. Journ. Bot. 8: 141. 1856. (Type from Brazil.)

Panus Infundibulum Berk. & Curt. Proc. Am. Acad. **4**: 121. 1860. (Type from Nicaragua.)

Panus cubensis Berk. & Curt. Jour. Linn. Soc. **10**: 300. 1868. (Type from Cuba.)

Lentinus vellereus Berk. & Curt. Jour. Linn. Soc. **10**: 301. 1868. (Type from Cuba.)

Lentinus estriatus Berk. & Br. Jour. Linn. Soc. **14**: 44. 1875. (Type from Ceylon.)

Agaricus (Clitocybe?) Calyx Speg. Anal. Soc. Ci. Argent. **16**: 243. 1883. (Type from Brazil.)

Lentinus (Scleroma) paraguayensis Speg. Anal. Soc. Ci. Argent. **16**: 275. 1883. (Type from Brazil.)

Crepidotus lentinoides Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 236. 1906. (Type from Cuba.)

This large and conspicuous species is abundant in the West Indies and the warmer portions of Central America and South America, but it has not been collected, I believe, in the Bahamas, Mexico, or the United States. Its surface may be velvety or glabrous, smooth or striate, according to exposure, weather, age, etc., and these variations occur also in India, Ceylon, Mauritius, Madagascar, and other parts of the oriental Tropics where it is common. To the above list of synonyms, should probably be added *Lentinus Kurzianus* Berk., *L. Thwaitesii* Berk. & Br., and a few other species; while *L. exilis* Kl., *L. praerigidus* Berk., and *L. Rivae* Bres. are very closely related. Discolored specimens from Guadeloupe have been determined as *L. melanophyllus* Lév., an oriental species.

Cuba, *Earle 298, Wilson 1350, Britton & Earle & Wilson 6010, Earle & Murrill 179, Wright;* Haiti, *Nash 148;* Porto Rico, *Earle 41, 72, E. G. Britton & Marble 618, Underwood & Griggs 1001;* Jamaica, *Underwood 1924, Earle 276, E. G. Britton 491;* Grenada, *Broadway;* St. Kitts, *Britton & Cowell 249;* British Honduras, *M. E. Peck;* Montserrat, *Shafer 910;* Brazil, *Weiss & Schmidt.*

3. LENTINUS ALBELLUS Pat. Bull. Soc. Myc. Fr. 15: 195. 1899

Known from a single collection by Duss in Guadeloupe. Types well preserved, showing points in common both with *Lentinus hirtus* and *Lentodium squamosum.*

4. LENTINUS TUBARIUS Pat. Bull. Soc. Myc. Fr. 15: 194. 1899

Known from a single collection by Duss in Guadeloupe. Similar to *L. hirtus* in many ways, but rufous in color and containing a large percentage of water, causing the specimens to shrink to one third their size in drying.

5. LENTINUS PYRAMIDATUS Berk. & Curt. Proc. Am. Acad. 4: 121. 1860

Collected originally in Nicaragua by the U. S. Exploring Expedition, and later in Mexico by C. L. Smith, who labeled it *L. villosus.* During the winter of 1907, Mr. M. E. Peck sent it to me from British Honduras. There are two good pencil sketches of it at Kew, but no specimens.

6. LENTINUS CRINITUS (L.) Fries, Syst. Orb. Veg. 77. 1825

Agaricus crinitus L. Sp. Pl. ed. 2. 1644. 1763. (Type from Jamaica.)

Agaricus Bertieri Fries, Syst. Myc. 1: 175. 1821. (Type from Guadeloupe.)

Lentinus nigripes Fries; Kl. Linnaea 8: 479. 1833. (Type from Mauritius.)

Lentinus villosus Kl. Linnaea 8: 479. 1833. (Type from Mauritius.)

Lentinus stuppeus Kl. Linnaea 8: 480. 1833. (Type from Mauritius.)

Lentinus tener Kl.; Fries, Syn. Gen. Lent. 6. 1836. (Type from Louisiana, according to Klotsch.)

Lentinus Swartzii Berk. Lond. Jour. Bot. 2: 632. 1843. (Type from Jamaica.)

Lentinus fumigatus Lév. Ann. Sc. Nat. III. **5**: 117. 1846. (Type from French Guiana.)

Lentinus Léveillei Berk. Trans. Linn. Soc. **20**: 112. 1851. (Type from Surinam.)

Lentinus nicaraguensis Berk. & Curt. Proc. Am. Acad. **4**: 121. 1860. (Type from Nicaragua.)

Lentinus Leprieurii Mont. Am. Sc. Nat. IV. **1**: 119. 1854. (Type from French Guiana.)

Lentinus Wrightii Berk. & Curt. Jour. Linn. Soc. **10**: 300. 1868. (Type from Cuba.).

Lentinus subcervinus Berk. & Curt. Jour. Linn. Soc. **10**: 300. 1868. (Type from Cuba.)

Lentinus rigidulus Berk. & Curt. Jour. Linn. Soc. **10**: 300. 1868. (Type from Cuba.)

Lentinus Schomburgkii Berk.; Sacc. Syll. Fung. **9**: 71. 1891. (Type from British Guiana.)

Pocillaria vestida Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 231. 1906. (Type from Cuba.)

There are no doubt other synonyms, but these will suffice for the present. *L. zonatus* Lév. has been applied to specimens collected in French Guiana by Leprieur, and *Xerotus reniformis* Mey, and *Xerotus tomentosus* Kl., to plants sent to Fries from Surinam by Wenck. *L. Zeyheri* Berk. is an oriental species nearly allied to the very villose forms.

This species is remarkable for its variations, especially in color and villosity, the extreme development of hairy covering being represented by *L. villosus, L. nigripes, L. stuppeus, Pocillaria vestida,* etc., in the above list. Sometimes the hairs are small and soft; and in most specimens the pileus tends to become bald with age, thus adding to the confusion. The plant is extremely common on exposed logs, having been collected throughout our entire tropical region, as well as in southern Florida, Mississippi, South America, and in the oriental Tropics. Over one hundred different collections have recently been brought to the Garden from tropical America.

7. LENTINUS CHRYSOPEPLUS Berk. & Curt. Jour. Linn. Soc. **10**: 301. 1868

The single specimen at Kew is well preserved and appears very distinct. The stipe resembles that of *L. crinitus,* but the pileus is adorned with a thick golden tomentum. The spores are ovoid, pointed at one end, smooth, hyaline, $7 \times 4\text{–}5\,\mu$.

8. LENTINUS STRIGELLUS Berk. & Curt. Jour. Linn. Soc. **10**: 302. 1868

Panus (*Eupanus*) *guaraniticus* Speg. Anal. Soc. Ci. Argent. **16**: 275. 1883. (Type from Brazil.)

Pocillaria simulans Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 232. 1906. (Type from Cuba.)

Pocillaria Palmeri Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 232. 1906. (Type from Cuba.)

This shapely and well-marked species, described from Cuba, is widely distributed in our region, as the list of specimens given below will indicate. Specimens at Kew labeled *Panus velutipes,* from Sante Comapam, Mexico, belong to this species.

Cuba, *Underwood & Earle 1504, 547, 408, 1515, 602, 435, 603, Shafer 218, 4487, Earle & Murrill 567, 489, 524, Palmer & Riley 597, Earle 80, 364, Wright, Britton & Earle & Gager 6826, 7517;* Porto Rico, *Britton & Cowell 1021, 1051;* Jamaica, *Earle 343, 94, 147, Murrill 201;* Guadeloupe, *Duss;* Cordoba, Mexico, *Sallé 102;* British Honduras, *M. E. Peck;* Panama, *Williams 1147;* Costa Rica, *Hoffmann;* Peru, *Matthews;* Brazil, *Balansa 3372.*

9. **Lentinus graminicola** sp. nov.

Pileus small, regular, funnel-shaped, 2–3 cm. broad, the central depression about 5 mm. wide; surface glabrous, smooth, isabelline; margin fibrillose, concolorous, deflexed on drying: context thin, rigid when dry; lamellae white, of medium breadth and distance apart, unequal, decurrent, edges entire: spores smooth, ovoid, hyaline, $7 \times 4\,\mu$: stipe gradually enlarged above, abruptly swollen at the base, glabrous, smooth, concolorous, solid, 2–3 cm. long, 2–3 mm. thick.

This species may be found in late summer among grass in the open pine lands of western Cuba, attached to old grass roots.

Type collected at Herradura in August, 1907, *F. S. Earle 574*. Also collected in the same locality in 1910, *Britton & Earle 6533*, and at Pinar del Rio, *N. L. Britton & E. G. Britton & C. S. Gager 7228*.

10. LENTINUS SCYPHOIDES Pat. Bull. Soc. Myc. Fr. 15: 195. 1899

Known only from the two collections of Duss in Guadeloupe. Specimens at Berlin are much discolored, but those in Patouillard's herbarium are in excellent condition. This species is quite distinct from *L. subscyphoides*, according to Patouillard.

11. **Lentinus subscyphoides** sp. nov.

Pileus very thin, nearly regular, funnel-shaped, 2–4 cm. broad; surface smooth, glabrous, avellaneous tinged with russet or fuliginous when young, becoming isabelline at maturity; margin involute, concolorous, glabrous: context thin, tough, rigid on drying; lamellae lilac when young, changing to isabelline, narrow, crowded, unequal, decurrent, a few of them bifurcate at the base, edges entire: spores ovoid, smooth, hyaline, $3.5 \times 2.5\,\mu$: stipe long, slender, slightly enlarged above and below, cinereous, pruinose, 2–3.5 cm. long, 1.5–2.5 mm. thick.

This species occurs from sea level to 1,500 feet elevation on the north shore of Jamaica, where I have studied it. Patouillard has specimens of it in his herbarium labeled *L. fuligineus* Berk. & Curt., which is a different plant, although the brief description agrees fairly well. *L. scyphoides* Pat. is closely related in form and microscopic characters, but is only one third as large.

Type collected at Moore Town, Jamaica, on dead sticks in dense woods, December 16, 1908, *W. A. & Edna L. Murrill 155*. Also collected in cocoanut plantations near Manchioneal, Jamaica, *W. A. & Edna L. Murrill 191, 194;* near Moneague, Jamaica, *W. A. & Edna L. Murrill 1130;* Martinique, *Duss 1849;* and British Honduras, *M. E. Peck*.

12. LENTINUS VELUTINUS Fries, Linnaea 5: 510. 1830

Panus velutinus Fries, Epicr. Myc. 398. 1838.

Lentinus ciliatus Lév. Ann. Sc. Nat. III. 5: 175. 1844. (Type from the Molucca Islands.)

Lentinus setiger Lév. Ann. Sc. Nat. III. **5**: 176. 1844. (Type from the Philippine Islands.)

?*Lentinus caelopus* Lév. Ann. Sci. Nat. III. **5**: 116. 1846. (Type from the United States.)

Lentinus echinopus Lév. Ann. Sci. Nat. III. **5**: 118. 1846. (Type from Java.)

Lentinus siparius Berk. & Curt. Jour. Linn. Soc. **10**: 301. 1868. (Type from Cuba.)

Lentinus blepharodes Berk. & Curt. Jour. Linn. Soc. **10**: 301. 1868. (Type from Cuba.)

Lentinus (*Scleroma*) *fallax* Speg. Anal. Soc. Ci. Argent. **16**: 274. 1883. (Type from Brazil.)

Lentinus castaneus Ell. & Macbr. Bull. Iowa. Lab. Nat. Hist. **3**: 194. 1896. (Type from Nicaragua.)

Pocillaria cinnamomea Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 231. 1906. (Type from Cuba.)

This distinct and striking species was first described from Brazil, in 1830, but it has since received many names, partially listed above, from various parts of the tropical world, where it occurs in great abundance. In tropical North America, there is only one species of the general type, and names have been assigned to variations in size, length of stipe, color, and the condition of the velvety covering due to age; in oriental tropical regions, however, there are many near relatives more or less distinct from our species, of which the following are good examples: *L. holopogonius* Berk., *L. fuscopurpureus* Kalchb., *L. Hookerianus* Berk., *L. nepalensis* Berk., *L. similis* Berk., *L. fastuosus* Lév., *L. fasciatus* Berk., and *L. zonatus* Lév. Its wide distribution in America, from the lowlands of Florida and Mexico to the subtemperate regions of South America, may be realized from the fact that it occurs in practically every locality within this range where botanical explorations have been made.

DOUBTFUL SPECIES

Lentinus furfurosus Fries, Epicr. Myc. 391. 1838. Based on *Agaricus omphalomorphus* Mont. from Chile. Specimens from Chile sent to Fries by Montagne are still at Upsala, but none so labeled were found from Costa Rica.

Lentinus glabratus Mont. Pl. Cell. Cuba 424. 1842. Type specimens at Paris collected by Sagra in Cuba very much resemble *Lentinula detonsa,* but differ in having decurrent gills and brown, marginal hairs. It is just possible that the two species have been confused, since a specimen at Kew sent by Montagne as *Lentinus glabratus* seems referable rather to *Lentinula detonsa.*

Lentinus chaetoloma Fries, Nova Symb. 34. 1851. Described from Oersted's collections in Costa Rica. Fries does not mention a figure, and no specimens were found. It is probably a thin, almost denuded form of *L. crinitus.*

Pocillaria reflexa Earle, Inform. An. Estaç. Centr. Agron. Cuba 1: 231. 1906. Type collected in Cuba by Earle and Wilson in 1904. A small, infundibuliform plant with very narrow gills, evidently closely related to *L. crinitus;* but authentic material has not been seen.

NEW YORK BOTANICAL GARDEN

A NEW HOST FOR CLAVICEPS

Herbert Groh

While making an examination of a quantity of wild hay received from Beauce County, in the province of Quebec, Canada, in December, 1909, I discovered that occasional spikes of a *Carex,* which constituted a large part of the hay, contained sclerotia of *Claviceps.* Suspecting this to be an exceptional host for the fungus, I made a search of the literature on the subject, with the result that I was unable to discover any record of a similar occurrence. Attempts were made to study the germination of the sclerotia, with a view to observing their further development, but, unfortunately, without success. The specimens were kept on moist, sterile sand in a Petri dish under ordinary living-room conditions of temperature, but, even after a lapse of several months, they had failed to develop stromata. Nothing is known of the history of the hay with which they had been gathered, and I have no doubt that age or the conditions of storage had influenced their power of germination. As no prospect remains now of gaining any more information about this interesting species, it seems advisable to put on record at least the fact of its discovery on *Carex.*

The sedge on which the sclerotia were found was identified as *Carex stellulata* Good. var. *angustata* Carey. Other Cyperaceae, including a number of other species of *Carex, Scirpus* and *Eriophorum,* and also a number of agricultural and wild grasses, were present, but on none of these were any sclerotia observed.

The appearance of the sclerotia *in situ* is shown in the accompanying drawing of representative specimens. Both macroscopically and microscopically, they are not unlike those occurring on grasses, and are undoubtedly *Claviceps* sclerotia. Their size varies from scarcely larger than the healthy perigynia to 5 mm. or more in length. Many of the smaller specimens appear to retain the features of the displaced perigynia at their tips.

With only this single stage of the fungus known, it is, of course, impossible to reach any conclusion as to its specific posi-

tion. It is not unlikely that it may be related to *Claviceps nigricans* Tul. occurring on *Eleocharis* and *Scirpus*, which are, I believe, the only members of the Cyperaceae at present recorded as being attacked by *Claviceps*. In this connection, mention may be made of a fungus described by Griffiths in the *Bulletin of the*

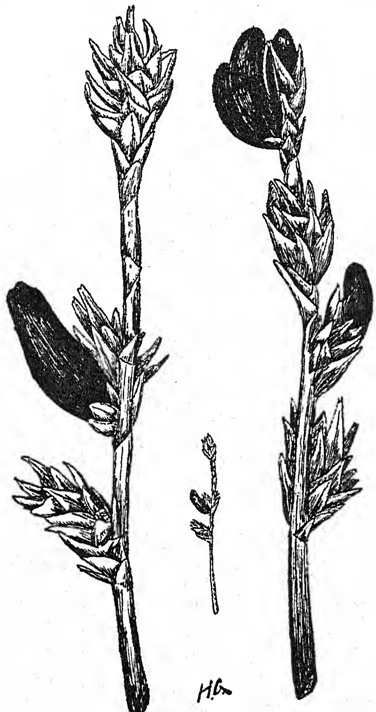


FIG. 1. Sclerotia of *Claviceps* on *Carex stellulata angustata*. $\times \frac{3}{5}$.

Torrey Botanical Club, Vol. 29, p. 300, and referred doubtfully to *Claviceps*. The sclerotial bodies there described were found, not on the reproductive organs, but inside the culms of the host, which was *Carex nebraskensis* Dewey. Through the courtesy of Dr. Griffiths I have been enabled to examine his specimens, which I find are clearly distinct from the ones under consideration here. They proved to be *Sclerotium sulcatum* Desm. (Ann. Sci. Nat. III. **16**: 329. 1851), with the conidial stage *Epidochium ambiens* Desm. (See Brefeld, Mycol. Unters. **10**: 317). The detached sclerotia of the fungus certainly resemble ergot grains very closely. The fungus of Dr. Griffiths was kindly determined by Mr. H. T. Güssow, Dominion Botanist.

A NEW GENUS OF MYXOMYCETES?

Thomas H. Macbride

(With Plate 36, Containing 7 Figures)

This following description and accompanying figures are submitted to mycologists partly for the sake of eliciting information. The author has had the material for some years but has been unable in any way, either through the literature at hand or through correspondence, to secure light as to its relationships.

The specimens look like those of a slime-mould, but the spores have so far refused to grow. If a slime-mould, the species is referable to the family Dianemeae and is akin to those in which the capillitial threads pass from side to side of the fructification, attached at each end.

The entire structure is set forth more or less diagrammatically in the accompanying plate, the drawings for which are by Miss Irma Uhde.

Schenella gen. nov.

Fructification aethalioid, depressed, flat, covered by a fragile but continuous crust: capillitium of simple threads twisted together to form vertical columns passing from the hypothallus to the outer peridium as if supporting it, but closely arranged; spores abundant, between the columns.

Schenella simplex sp. nov.

Fructification white, oval, about 2×4 cm. in extent and about 3 mm. thick: capillitium abundant, dark-brown, exposed by the breaking up of the crust-like peridium, and, when this is removed, having the appearance of a colony of *Stemonitis,* each column being made up of a number of smooth, tubular, unsegmented threads twisted together so as to form a cord, and, in some instances, covered in whole or in part by a delicate common sheath: spores spherical, smooth, 5–6 μ.

Type collected in August, 1903, on a decaying pine log in the Yosemite Valley, California, *T. H. Macbride.*

Iowa City, Iowa.

EXPLANATION OF PLATE 36

1. A single plant. × 5.

2. Section showing the columns of the capillitium supporting the peridium.

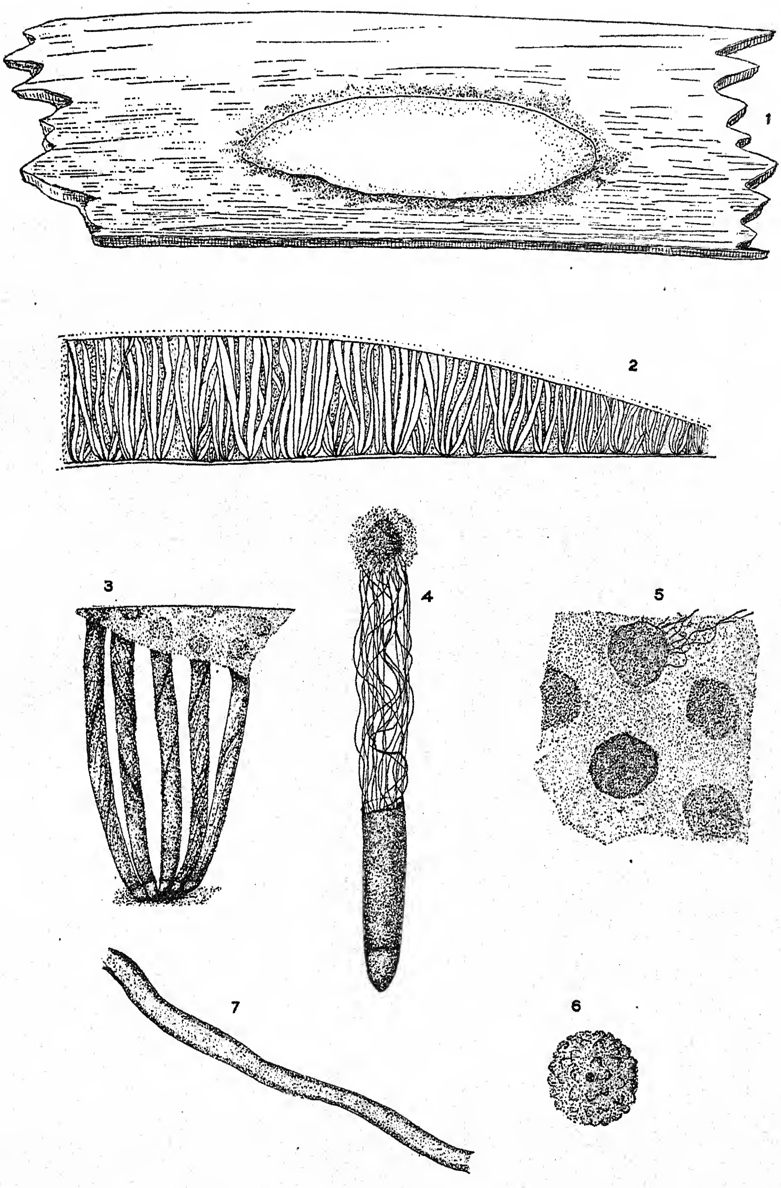
3. A small portion of the peridium with the supporting capillitial columns, more highly magnified.

4. A single column showing the component threads. × 30.

5. A portion of the peridium. × 40.

6. A spore. × 5000.

7. A portion of one of the component threads. × 3000.



SCHENELLA SIMPLEX MACBRIDE

NEWS AND NOTES

Professor Bessey has recently estimated the number of species of plants to be about 210,000, of which over 60,000 are fungi.

Mr. L. H. Pennington, instructor at Northwestern University, has been appointed assistant professor of botany at Syracuse University.

A practising physician in Switzerland recently treated a patient who was badly poisoned by eating *Clitocybe geotropa.*

Authors publishing new species in MYCOLOGIA are requested to donate, if possible, specimens or fragments of these species to the New York Botanical Garden.

The mushroom market at Lausanne, Switzerland, opening May 1 and closing December 1, contained during the season of 1909 a total of 106 species, of which 15 were poisonous.

An interesting polypore recently described by Schestunoff in *Hedwigia* as *Bresadolia caucasica,* has been found by Magnus to be only a monstrous form of *Polyporus squamosus* (Huds.) Fries.

Scleroderma Geaster, described and figured in the January number of this journal for 1910, suddenly appeared in great quantities last September on a lawn at Shelter Island, practically covering the ground in many places and destroying most of the grass.

Chemical tests have been employed by the French mycologists Maire and Potron in distinguishing certain species of *Russula.* The pigment is dissolved in boiling water and the effect of acetic acid on the colored solution noted (Bull. Soc. Myc. Fr. **26**: 327).

Dr. B. F. Lutman, of the Vermont Agricultural Experiment Station, visited the Garden on January 3.

Mr. Lars Romell, of Stockholm, Sweden, an authority on fleshy fungi, some time ago made a personal test of the poisonous properties of fresh plants of *Entoloma lividum*, with almost fatal results. He followed this up with a plant of *Amanita muscaria* which had been boiled five minutes in water, and the effect on his system was not noticeable. Such experiments should be made with great caution.

The "Shiitake," an edible mushroom cultivated for centuries in Japan on decaying trunks of oak and hornbeam sprinkled at intervals with rice water, has been found to have several scientific names. Specimens obtained from shops in Japan by the Challenger Expedition in 1875 were named *Agaricus* (*Armillaria*) *edodes* by Berkeley (Jour. Linn. Soc. Bot. **16**: 50. 1878), this being the first name applied and the best classification of the species. Specimens obtained in Japan in 1873 were assigned a herbarium name, *Agaricus* (*Pleurotus*) *russaticeps*, by Berkeley, which was published by Cooke (Grevillea **16**: 106. 1888) ten years after *A. edodes* was published. Schröter, in *Gartenflora* for 1886, described the same species from dried material as *Collybia Shiitake;* while Hennings, on receiving alcoholic specimens from Shirai, discovered a veil in the younger sporophores and transferred it to the genus *Cortinellus*, changing the name to *Cortinellus Shiitake* (Schröt.) P. Henn. Excellent specimens have been sent to the Garden by Professor Kusano, of Tokyo, during the past year, and others have been bought in the Chinese shops of New York City. The species is a good *Armillaria*, but it resembles *Marasmius* both in appearance and habit of growth.

At the recent Minneapolis Meeting, Dr. C. E. Bessey, Professor of Botany of the University of Nebraska, was elected President of the American Association for the coming year; Dr. F. C. Newcombe, of the University of Michigan, was elected Vice-president of Section G; and Dr. W. G. Farlow, of Harvard Uni-

versity, was elected President of the Botanical Society of America.

Mr. F. J. Veihmeyer, of the Bureau of Plant Industry at Washington, spent several days at the Garden during the holidays, consulting the collections of fungi made by Langlois, Calkins, and others.

In the *Botanical Gazette* for November, 1910, Miss R. H. Lovejoy describes a new genus, *Catathelasma,* and six new species of hymenomycetes collected in the Medicine Bow National Forest, in the Rocky Mountain region of Wyoming. Miss Lovejoy promises to continue her collections in this new and interesting region.

The Fungi of Chile have recently been treated by Spegazzini in a work containing 205 pages and 129 text figures. Of the 326 species and varieties listed, 121 are pyrenomycetes, of which 105 are described as new, and 35 are discomycetes, of which 24 are new. The small number of hymenomycetes, only 15, indicates the almost total lack of information regarding this large and important group.

Volume 3, part 1, of *North American Flora,* comprising 88 pages of text, appeared December 29, 1910. It contains the order Hypocreales, with the families Nectriaceae and Hypocreaceae, by Fred J. Seaver; and the Fimetariales, with the Chaetomiaceae, by Helen L. Palliser, and the Fimetariaceae (Sordariaceae), by David Griffiths and Fred J. Seaver. Some of the species here treated, especially those belonging to the genus *Nectria,* are injurious to cultivated plants, while many of the species of *Cordyceps* live upon and aid in destroying injurious insects.

A number of new species of fungi were recently descibed by Dr. Chas. F. Fairman (Ann. Myc. **8**: 322–332. 1910) under the title "*Fungi Lyndonvillenses novi vel minus cogniti.*"

Dr. C. L. Shear has, upon request, kindly contributed the following note regarding the meeting of the American Phytopathological Society at Minneapolis.

The meeting of the phytopathologists was very well attended. The following officers were elected: President, Professor A. D. Selby, Wooster, Ohio; Vice-president, Dr. R. A. Harper, University of Wisconsin; Secretary-Treasurer, Dr. C. L. Shear; Councilmen: Dr. G. P. Clinton and Dr. Erwin F. Smith. The President of the Society, and the Chairman of the Board of Editors, Dr. L. R. Jones, are members *ex officio* of the Council.

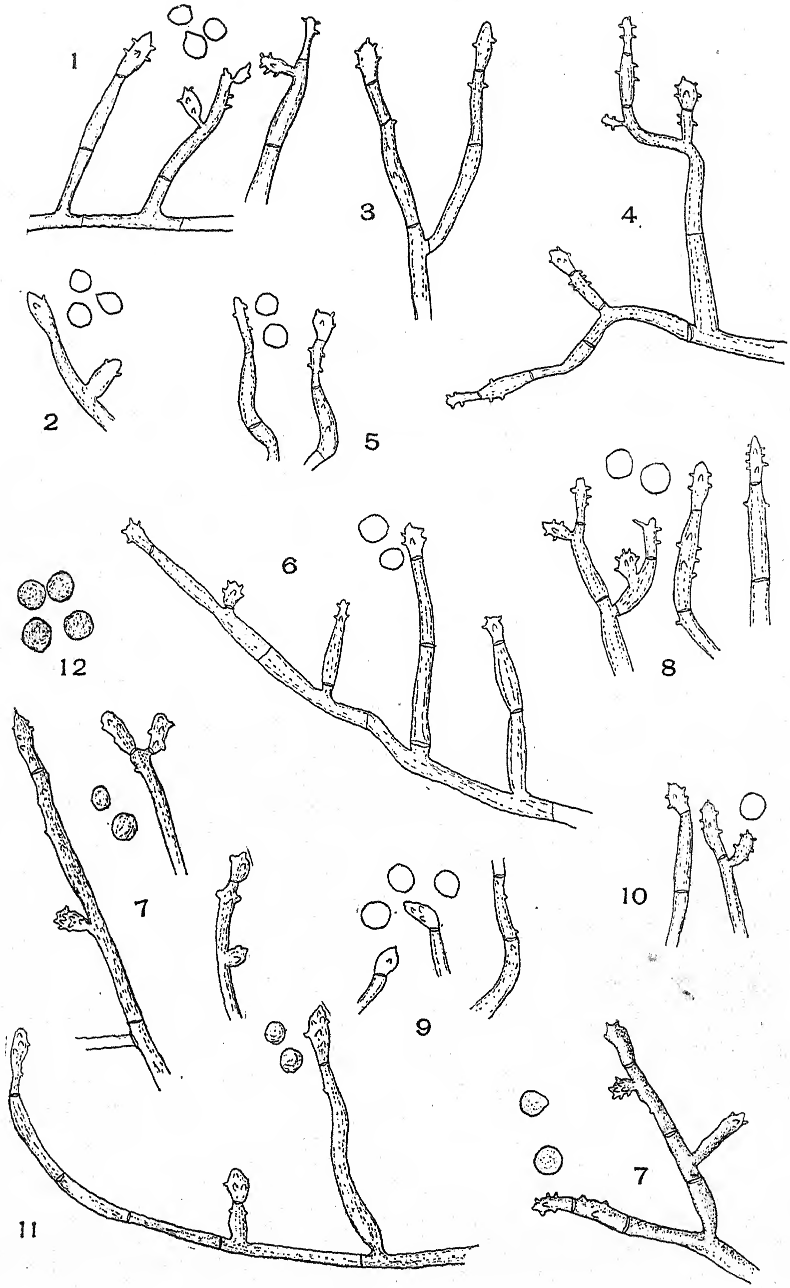
The Society approved the recommendation of the Council to publish a Journal to be known as "*Phytopathology*." The first number will appear February 1. The following editorial board was appointed:

Editors: L. R. Jones, C. L. Shear, H. H. Whetzel.

Associate Editors: G. P. Clinton, E. W. Freeman, H. T. Güssow, F. D. Heald, Haven Metcalf, W. A. Orton, W. M. Scott, A. D. Selby, Erwin F. Smith, Ralph E. Smith, F. L. Stevens, L. M. Thaxter.

Business Manager: Donald Reddick.

Stevens and Hall have described (Bot. Gaz. **50**: 460–463. 1910) three new species of *Claviceps*, as follows: *Claviceps Paspali*, *Claviceps Rolfsii*, and *Claviceps Tripsaci*. The first two occur on species of *Paspalum* and differ in the length of stipe and in the size of the perithecia, asci, and spores. Both are associated with what has been known as *Sclerotium Paspali* Schw., two species probably having been included under the same name. *Claviceps Tripsaci* occurs on *Tripsacum dactyloides* L.



RHINOTRICHUM

MYCOLOGIA

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STUDIES IN NORTH AMERICAN HYPHOMYCETES—I

THE GENERA RHINOTRICHUM AND OLPITRICHUM

DAVID ROSS SUMSTINE

(WITH PLATES 37–39, CONTAINING 40 FIGURES)

This group of fungi is a heterogeneous mass of unrelated genera and species and seems to have been rather studiously avoided by American mycologists. The literature on the North American species is exceedingly rare. Several genera of leaf parasites have been studied but otherwise little has been done in the group. Pound and Clements* have re-arranged the whole group with reference to the North American species.

Many species are known to be the conidial stages of ascomycetes and should be excluded from the group. The following genera contain species that have been definitely associated with other fungi, *Oidium, Polythrincium, Verticillium, Diplocladium, Dactylium, Mycogone,, Acrostalagmus, Sepedonium, Isaria, Hadrotrichum, Oedocephalum.*

Some genera are autonomous but a study of their structure and their fructification shows that their affinity is with other groups. Among such genera are the following: *Microstroma, Myxotrichum, Aspergillus, Penicillium, Zygodesmus.*

With our limited knowledge of this perplexing group it is better to defer the arrangement of it until a more exhaustive study of the genera and species has been made.

* Minn. Bot. Studies 9: 644–673. 1896. Ibid. 726–738. 1897.

[MYCOLOGIA for January, 1911 (3: 1–44), was issued January 31, 1911]

My thanks are due to Dr. N. L. Britton, of the New York Botanical Garden, for permission to examine the collection in the herbarium, and to Mr. Sydney Prentice, of Pittsburgh, for assistance in making the drawings. The kind assistance of other persons is acknowledged in the proper place under the discussion of different species.

RHINOTRICHUM Corda, Ic. Fung. 1: 17. 1837

Physospora Fries, Summa Veg. Scand. 495. 1849.

Type species, *Sporotrichum rubiginosum* Fries.

ORIGINAL DESCRIPTION: Flocci erecti, septati, supra verrucosi; sporis simplicibus verrucis innatis, dein deciduis et hylo instructis. Fries describes the genus *Physospora* as follows: Flocci caespitosi, septati, persistentes, demum laxi, sporis vesiculosis, simplicibus, e floccorum verrucis enatis adspersi.

Type species, *Rhinotrichum simplex* Corda.

Saprophytic or parasitic(?); mycelium creeping, septate, intricately interwoven, forming a loose or sometimes rather dense stratum; fertile branches erect or suberect, simple or branched; spores simple, colorless or slightly colored, borne on spicules (sterigmata) on the ultimate divisions (basidia) of the fertile branches.

Rhinotrichum canescens Speg., parasitic on leaves, has been reported from Paraguay. If this is a true *Rhinotrichum* it is the only parasitic species known. All other known species grow on decaying wood or stems, usually on the under side.

The genus *Physospora* is not necessary, as the species under it may well be included under the genus *Rhinotrichum* as defined above. The difference lies chiefly in the swollen divisions of the fertile branches of the former. But all branches are not swollen, some are attenuated as in some species of *Rhinotrichum*.

Either *Physospora* must be reduced to synonymy or else the species *R. Curtisii* and *R. ramosissimum* must be transferred to *Physospora*. The differences in this case are not sufficient to justify two distinct genera.

The genera *Rhinotrichum* and *Botrytis* are somewhat related. In the latter the spores are clustered at the tips of the fertile branches, while in the former the spores are more or less scattered on the ultimate division or divisions of the fertile branches.

The genus *Sporotrichum* is also closely allied to *Rhinotrichum*, the chief difference being the procumbent fertile branches of the former. It is possible that a study of the described species of *Sporotrichum* will add a number of species to *Rhinotrichum*.

KEY TO THE SPECIES

Spores globose or nearly so.	
Spores smooth.	
Stratum reddish-brown.	1. *R. rubiginosum.*
Stratum yellow-rust color.	2. *R. subferruginosum.*
Stratum yellow to brown.	
Spores large, 15–16 μ.	3. *R. fulvum.*
Spores smaller.	
Stratum yellow.	4. *R. Curtisii.*
Stratum yellow-brown.	5. *R. laevisporum.*
Spores not smooth.	
Spores granular.	6. *R. armeniacum.*
Spores roughened, 5 μ.	7. *R. carneum.*
Spores roughened, 8–10 μ.	8. *R. subalutaceum.*
Spores not globose.	
Stratum white to cinereous.	9. *R. repens.*
Stratum sulphur-colored.	10. *R. sulfureum.*
Stratum light-brown.	11. *R. bicolor.*
Stratum light-yellow.	12. *R. tenerum.*
Stratum tan-yellow.	13. *R. ramosissimum.*

1. **Rhinotrichum rubiginosum** (Fr.)

Sporotrichum rubiginosum Fries, Syst. Myc. 3: 417. 1829.
Physospora rubiginosa Fries, Summa Veg. Scand. 495. 1849.

Stratum very thin, cespitose, reddish-brown, rubiginose; hyphae septate, branching, 6–8 μ thick; fertile branches erect, simple or branched, ultimate divisions usually swollen, sometimes attenuate, bearing the smooth, concolorous, globose-obovoid, 11–15 μ spores.

On bark and wood.

SPECIMENS EXAMINED: Canada, *Ellis Collection 1623;* New York, *Peck.*

2. **Rhinotrichum subferruginosum** sp. nov.

Stratum thin, floccose, bright yellow-rust color, ferruginous; hyphae branched, septate, 8–10 μ thick; fertile branches erect or suberect, branched, attenuated upwards or ultimate divisions swollen; spores borne on several divisions of the fertile branches, smooth, globose, colored, 14 μ.

On bark, woodpile, Hope, Jamaica, October 25, 1902.

SPECIMENS EXAMINED: Jamaica, *Earle 93* (type).

The type specimen is at the New York Botanical Garden.

3. RHINOTRICHUM FULVUM Berk. & Curt. Grevillea 3: 108. 1874

Stratum thin, fulvous; hyphae septate; fertile branches septate, ultimate divisions elongate, with spicules; spores subglobose, granular, 15–16 μ.

SPECIMENS EXAMINED: South Carolina, *Ravenel* (type, spores only).

The description is compiled largely from the original, as the material at hand was too meager for proper study. It seems very near *R. Curtisii*. *Rhinotrichum Thwaitesii* var. *fulvum* Grove is reported from England. It has verrucose spores, 7–10 μ.

4. RHINOTRICHUM CURTISII Berk. Grevillea 3: 108. 1875

Rhinotrichum Sumstinei Peck, Bull. Torrey Club 34: 103. 1907.

Stratum effused, thick, golden-yellow, brownish in older specimens; hyphae branched, septate, 8–12 μ thick; fertile branches erect, branched, septate, ultimate divisions usually swollen, covered with spicules; spores globose or subglobose, smooth, variable in size, 12–16 μ.

On decayed wood.

SPECIMENS EXAMINED: New York, *Peck;* Pennsylvania, *Sumstine;* Ohio, *Kellerman;* South Carolina (type).

In the original description, *Aspergillus laneus* Schw. is given as a synonym. The specimen in the Academy of Sciences, Philadelphia, marked *Aspergillus laneus* is too scanty for proper identification and therefore the real relationship between these two species could not be definitely determined.

Rhinotrichum Sumstinei does not seem to be specifically different. The size and the shape of the spores agree with *R. Curtisii.* The color is given as "tawny-brown." The type at Albany and the cotype in the Carnegie Museum, Pittsburgh, were examined.

The color of this species as well as of other species depends very much upon the exposure to the sunlight. When exposed to strong sunlight the color becomes darker, even brown. In a shady or secluded place the lighter shades of yellow predominate.

5. **Rhinotrichum laevisporum** (Cooke)

Zygodesmus laevisporus Cooke, Grevillea 6: 139. 1878.

Stratum thin, effused, ochraceous yellow-brown; hyphae sparingly branched, septate, 6–8 μ thick; fertile branches erect, septate, apex swollen with few spicules, frequently the ultimate and penultimate divisions with spicules; spores globose, smooth, 10–14 μ.

On decayed wood.

SPECIMENS EXAMINED: Louisiana, *Ravenel 58.*

This species is near *R. Curtisii.* The few spicules chiefly distinguish it from that species.

6. RHINOTRICHUM ARMENIACUM Berk. & Curt. Grevillea 3: 108. 1875

Stratum thin, yellow to yellow-brown; hyphae branched, spinulose, occasionally portions smooth, septate, 6–8 μ thick; fertile branches spinulose, attenuate upwards, septate (?); spores globose, colored, granular, 14–15 μ.

On decayed wood.

SPECIMENS EXAMINED: South Carolina, *3011* (type).

The authors characterize it as, "Forming a thin apricot-colored stratum; flocci ascending, articulated, the ultimate joints much elongated, granulated; spores globose."

The color apparently is yellow or yellowish-brown. The spinulose hyphae and larger spores separate it from *R. subalutaceum.*

7. RHINOTRICHUM CARNEUM Ellis & Ev. Jour. Myc. 1: 93. 1885

Stratum loose, floccose, dull-white at first, then flesh-colored; hyphae 6–8 μ thick; fertile branches obtusely rounded at the apex, with minute spicules, septate; spores globose, delicately spinulose, 5 μ.

On decayed wood.

SPECIMENS EXAMINED: Canada, *Macoun;* Oregon, *Carpenter 125* (type).

A study of better material may place this species in some other genus.

8. RHINOTRICHUM SUBALUTACEUM Peck, Ann. Rep. N. Y. State Mus. 34: 51. 1881

Stratum thin, effused, yellow-brown, alutaceous, paler on the margin; hyphae branched, intricately interwoven, smooth, septate, 8–12 μ thick; fertile branches generally short, sometimes elongate, non-septate, usually abruptly narrowed at the apex, which bears the minute spicules; spores concolorous or lighter, globose, under high power of the microscope slightly roughened or echinulate, 8–10 μ.

On decayed wood.

SPECIMENS EXAMINED: Iowa, *Holway 295;* New York, *Peck* (type).

The type was collected in the Helderberg Mountains, N. Y. The species is readily distinguished by the short fertile branches.

9. RHINOTRICHUM REPENS Preuss; Sturm, Deutsch. Fl. 6: 43. 1862

Stratum thin, effused, white to cinereous; hyphae creeping, septate, branched, 6–8 μ thick; fertile branches erect, septate, simple, equal or slightly attenuate upwards; spores ovoid-ellipsoid, smooth, 12–16 μ, occasionally with nucleus or with granular appearance.

On decayed wood.

SPECIMENS EXAMINED: Massachusetts, *Farlow* (in the herbarium of Dr. Fairman 1086).

10. RHINOTRICHUM SULFUREUM Ellis & Ev. Bull Torrey Club 11: 18. 1884

Stratum effused, thin, pale sulfur-colored, nearly white at first; hyphae branched, septate, 7–8 μ thick; fertile branches erect, simple, septate, some gradually attenuate above, others equal or somewhat enlarged, several divisions bearing spicules; spores obovoid-ellipsoid, granular, 9–10 $\times$ 11–15 μ.

On decayed wood.

SPECIMENS EXAMINED: Iowa, *Holway 296* (possibly part of the type); New Jersey, *Ellis 1662;* New York, *Fairman 1088.*

The New Jersey specimen is very thin, brownish-yellow, spores 11 $\times$ 16 μ. The color may be due to age.

11. **Rhinotrichum bicolor** sp. nov.

Stratum effused, thin, light-brown to alutaceous, dirty-white on the margin; hyphae branched, septate, hyaline or slightly col-

ored, 6–8 μ thick; fertile branches long, simple, erect, attenuate upwards, the ultimate divisions spiculiferous; spores obovoid-ellipsoid, smooth, colored, 8–10 by 10–16 μ.

On decayed wood.

SPECIMENS EXAMINED: New York, *O. F. Cook 244;* Pennsylvania, *Sumstine* (type), *Ellis & Harkness 3331.*

The margin is white or dirty-white, the brown color appearing near the center. Part of the original collection is deposited at the New York Botanical Garden. The type is in the Carnegie Museum, Pittsburgh.

12. **Rhinotrichum tenerum** sp. nov.

Stratum effused, thin, sometimes collected in rather thick patches, light-yellow, almost white on the margin; hyphae septate, branched, with numerous H-shaped formations, 5–6 μ thick; fertile branches erect, septate, attenuate upwards, the last few divisions bearing the prominent spicules; spores globose-ellipsoid, hyaline or nearly so, smooth with granular contents, 8–11 $\times$ 10–15 μ.

On decayed wood.

SPECIMENS EXAMINED: Louisiana, *Langlois 2479.*

The specimens are in the Ellis collection in the New York Botanical Garden and are labeled *Rhinotrichum tenerum* E. & E. n. sp. I was unable to find any published description of this species and have presumed that the name has not been published. The following descriptive note is found on the label: "Hyphae hyaline, septate, branched, evanescent, 5–6 μ thick, the terminal segments spiculiferous and bearing the globose, subelliptical, yellowish, hyaline, 8–10 μ, smooth conidia with granular contents."

13. RHINOTRICHUM RAMOSISSIMUM Berk. & Curt. Grevillea 3: 108. 1875

Stratum effused, thick or sometimes thin, yellow, alutaceous, tan-colored hyphae branched, septate, 8–10 μ thick; fertile branches erect, branched, septate, ultimate divisions elongate or swollen, covered with spicules; spores obovoid, frequently apiculate, smooth, variable in size, 8–12 $\times$ 13–16 μ.

On decayed wood.

SPECIMENS EXAMINED: New Jersey, *Ellis;* New York, *Peck;* Pennsylvania, *Sumstine;* South Carolina (type).

In the collection at Albany, Peck marked a specimen var. *marginatum*. It has a light-yellow margin, but otherwise agrees with the type.

This species is exceedingly variable in color and in size of spores, although the shape of the spores is rather uniform. The species is, no doubt, cosmopolitan.

DOUBTFUL SPECIES

1. *Rhinotrichum herbicolum* Ellis and Dearness, Proc. Canadian Inst. 1: 90. 1897. "Effused, light yellow, becoming brown in the centre. Hyphae, coarse, septate, branched, nearly hyaline, 8–10 μ thick. Fertile hyphae, sub-undulate above, tips swollen and bearing the globose, sub-hyaline, finely echinulate, 7–9 μ conidia.

"On dead stems of *Solidago canadensis,* London, Can., Aug., 1895."

The species is said to differ from *R. Curtisii* in its coarser hyphae and in its smaller echinulate conidia. The specimen in the Ellis collection in the New York Botanical Garden, which is probably a part of the type collection, shows the spores clustered at the apex of the fertile branches. Better material is necessary before its proper place can be determined. It resembles in many respects *Botrytis fulva* Link.

2. *Rhinotrichum bellum* Berk. & Curt. Grevillea 3: 108. 1875. "Vivide aurantiacum, effusum; sporis oblongo-ellipticis.

"Dead wood, Ala. Beaumont 4865."

No specimen of this species was examined by me and so far as known it has not been found since its first discovery.

3. *Rhinotrichum pulveraceum* Ellis; Kellerman, Jour. Myc. 1: 47. 1885. "Forming a thin pale, yellowish white, subgranulose layer on the matrix; hyphae much branched, the ends swollen and smooth; the conidia (appearing at first inside these swollen ends and pushing out through the investing membrane?) variable in size and shape, globose, 5–9 μ in diameter or elliptical, 5–12 $\times$ 5–7 μ. The elliptical conidia mostly with a slight apiculus at one end. The branching hyphae are sparingly septate and mostly not over 3 μ in diameter.

"Peculiar in the smooth swollen tips. The sterile hyphae form

a thin, white, soft layer like a Corticium on the surface of the wood.

"On dead wood and bark. Topeka, Kansas."

The type is not accessible and the description not clear enough for exact determination.

EXCLUDED SPECIES

1. *Rhinotrichum fusiferum* Berk. & Curt. Grevillea 3: 108. 1875. The original description is exceedingly short and might apply to a number of fungi.

"Dull yellow, flocci short, inarticulate, studded above with the fusiform spores, .0016′–0015′ long.

"A very pretty species. Car. Inf. 4964."

The part of the type specimen sent from Berkeley's herbarium was too meager for identification. A number of fusiform spores 5–36 μ were found in the material. The spores seemed granular or even warted and some seemed to be septate. Too little is known about this species to assign it definitely to any genus.

2. *Rhinotrichum breve* Berk. & Curt. Grevillea 3: 109. 1875. The label also bears the name *Aspergillus affinis*. The spores in the type specimen agree very well with the description but the attachment of the spores could not be satisfactorily determined. It evidently does not belong to the genus *Rhinotrichum*. The specimen was collected in South Carolina.

3. *Rhinotrichum doliolum* Pound and Clements, Bot. Sur. Neb. 4: 5. 1896.

"Effused, white, compact, velvety, gray, or drab; sporophore ascending much branched; filaments hyaline, tortuous, many septate, 5 μ wide, thickly beset with bottle-shaped basidia, 7–8 $\times$ 3–4 μ, generally opposite, rarely alternate; conidia 2–several on each basidium, borne on short sterigmata, hyaline, ovoid-ellipsoid 3–5 $\times$ 2–3 μ.

"Forming a thick crust on the sporangia and stipes of a slime mould, bluffs of the Missouri river, Bellevue (4381)."

This species evidently does not belong to *Rhinotrichum* as defined in this paper. The basidia (?) with 2–several spores point to the genus *Olpitrichum*. The type specimen has been lost or destroyed.

My thanks are due to Dr. Clements, of the University of Minnesota, and Dr. Bessey, of the University of Nebraska, for information concerning this species.

4. *Physospora elegans* Morg. Jour. Cinc. Soc. Nat. Hist. **17**: 44. 1875. Not *Physospora elegans* Cav. "Effused thin, flocculose, then pulverulent, bright ochraceous; hyphae long, slender, creeping, septate, dilute ochraceous, much branched and interwoven, producing everywhere short erect inflated vesicles. These vesicles ellipsoid, obovoid, or quite irregular, 14–20 × 9–12 mic. bearing at the apex usually two (1–3) spores on short blunt pedicels; spores globose, ochraceous 16–20 mic. in diameter.

"Growing on rotten oak trunks. Preston, Ohio."

The type specimen is no longer in existence but through the kindness of Dr. Macbride, of the University of Iowa, the original drawing made by Mrs. Morgan was sent to me for examination. The species is remarkable for the many clamp connections in the hyphae. It is closely allied to the genus *Zygodesmus*. Possibly it would be better to establish a new genus for this species.

5. *Rhinotrichum muricatum* Ellis and Ev. Proc. Acad. Phila. 86. 1891. The specimen in the New York Botanical Garden labeled with this name is very clearly not a *Rhinotrichum*.

6. *Rhinotrichum corticioides* Cooke, Grevillea **13**: 27. 1883. The specimen was collected in South Carolina by Ravenel. It belongs to the Thelophoraceae, probably *Hymenochaete Ellisii* Berk. and Cooke. Part of the type was examined.

7. *Rhinotrichum macrosporum* Farlow. See under the genus *Olpitrichum*.

8. *Rhinotrichum tenellum* Berk. & Curt. See in a later paper under the genus *Gonatobotrys*.

9. *Rhinotrichum cucumerinum* Berk. & Curt. See in a later paper under the genus *Gonatobotrys*.

OLPITRICHUM Atkinson, Bot. Gaz. **19**: 244. 1894

Saprophytic; mycelium septate, branched, interwoven; fertile branches erect, simple or branched, septate, ultimate divisions with flask-shaped fusoid or irregular processes (sterigmata) at the top bearing the simple, hyaline or pale-colored spores.

Type species, *Olpitrichum carpophilum* Atkinson.

This genus bears some resemblance to *Rhinotrichum* as the author states: "It is *Rhinotrichum* but with inflated basidia which are constricted at the point of union with the hyphae." In the original description the irregular spore-bearing processes are called basidia but to me the term sterigmata seems more appropriate.

KEY TO THE SPECIES

Spores very irregular.	1. *O. carpophilum.*
Spores regular or nearly so.	2. *O. macrosporum.*

1. OLPITRICHUM CARPOPHILUM Atkinson, l. c.

Stratum thin, white, or slightly colored; hyphae branched, septate, creeping, 5–8 μ thick; fertile branches erect, simple or branched, septate, bearing at the apex flask-shaped, fusoid, or enlarged processes (sterigmata) irregularly scattered or gregarious; spores ovoid-oblong, hyaline or pale-colored, irregular, 13–16 $\times$ 18–30 μ.

On *Gossypium herbaceum.*

SPECIMENS EXAMINED: Alabama, *Atkinson* (type).

The spores are exceedingly variable in shape and size. Very irregular bodies are developed on some of the fertile branches. The real nature of these bodies is not known. A careful examination did not reveal anything that resembled sterigmata.

I am indebted to Professor Atkinson, of Cornell University, for a slide of the type material.

2. **Olpitrichum macrosporum** (Farlow)

Rhinotrichum macrosporum Farlow; Sacc. Michelia **2**: 148. 1880.

Stratum effused or pulvinate, sordid-white; hyphae branched, septate, 8 μ thick; fertile branches erect, remotely septate, slightly colored, bearing near the apex irregular or sometimes branched processes (sterigmata); spores ovoid or obovoid, smooth, hyaline or slightly colored, 16 $\times$ 30–35 μ.

SPECIMENS EXAMINED: Louisiana, *Ellis Collection 1653.*

The specimens in the Ellis collection were evidently communicated by Dr. Farlow and in all probability are part of the original collection.

The principal difference between the two species is in the form of the spores. When more and better material is studied these two species may prove to be the same.

HIGH SCHOOL,
PITTSBURGH, PA.

EXPLANATION OF PLATE 37 (frontispiece)

All the figures on this and the following plates were drawn with the aid of the camera lucida and are highly magnified. The drawings show the fertile branches and the spores unless otherwise indicated.

1–2. *Rhinotrichum rubiginosum* (Fr.) Sumstine.

3–5. *Rhinotrichum subferruginosum* Sumstine. From type.

6–11. *Rhinotrichum Curtisii* Berk. 9 and 10, from type material; 7, from type of *R. Sumstinei* Peck.

12. *Rhinotrichum fulvum* Berk. & Curt. From type material. Spores only.

EXPLANATION OF PLATE 38

1–2. *Rhinotrichum laevisporum* (Cooke) Sumstine.

3–4. *Rhinotrichum armeniacum* Berk. & Curt. From type material.

5. *Rhinotrichum carneum* Ellis & Ev. From type material.

6–9. *Rhinotrichum subalutaceum* Peck. From type material.

10. *Rhinotrichum repens* Preuss.

11–12. *Rhinotrichum sulfureum* Ellis. & Ev. 11, possibly from part of type.

13–15. *Rhinotrichum bicolor* Sumstine. From type.

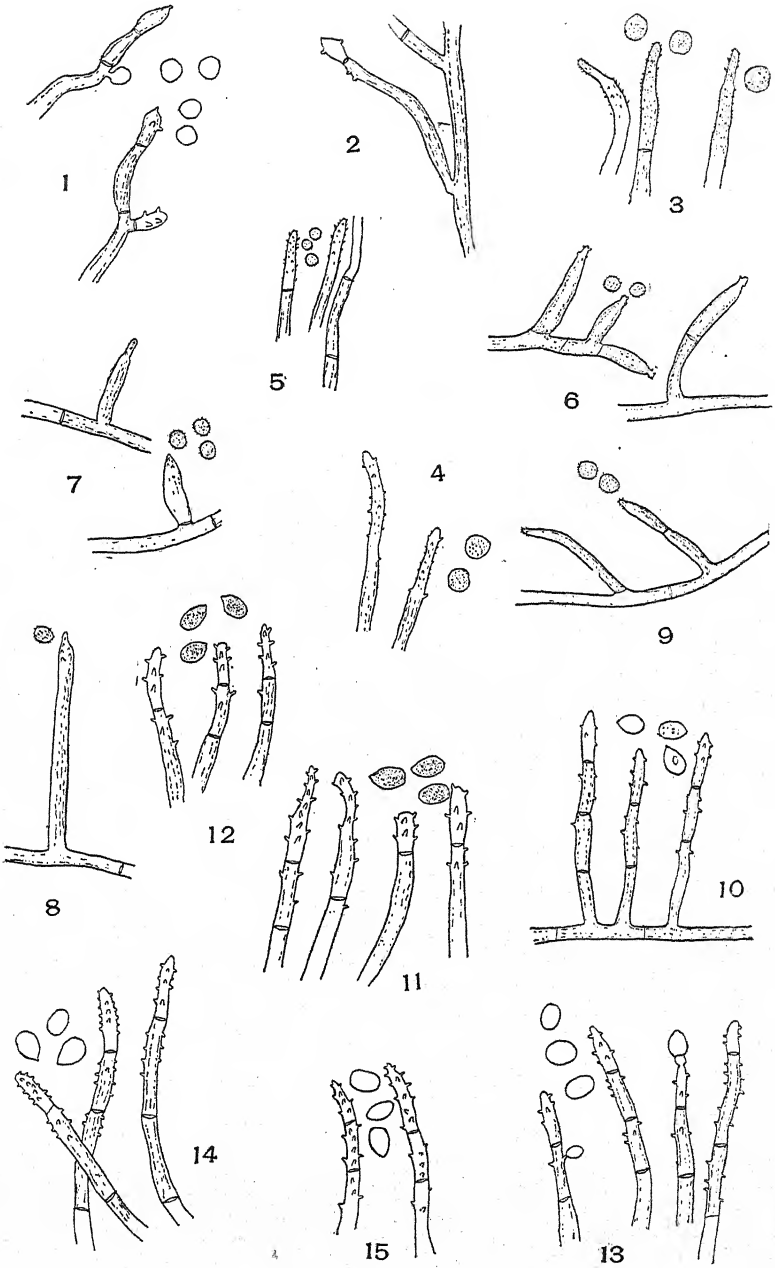
EXPLANATION OF PLATE 39

1. *Rhinotrichum tenerum* Ellis & Ev. Type.

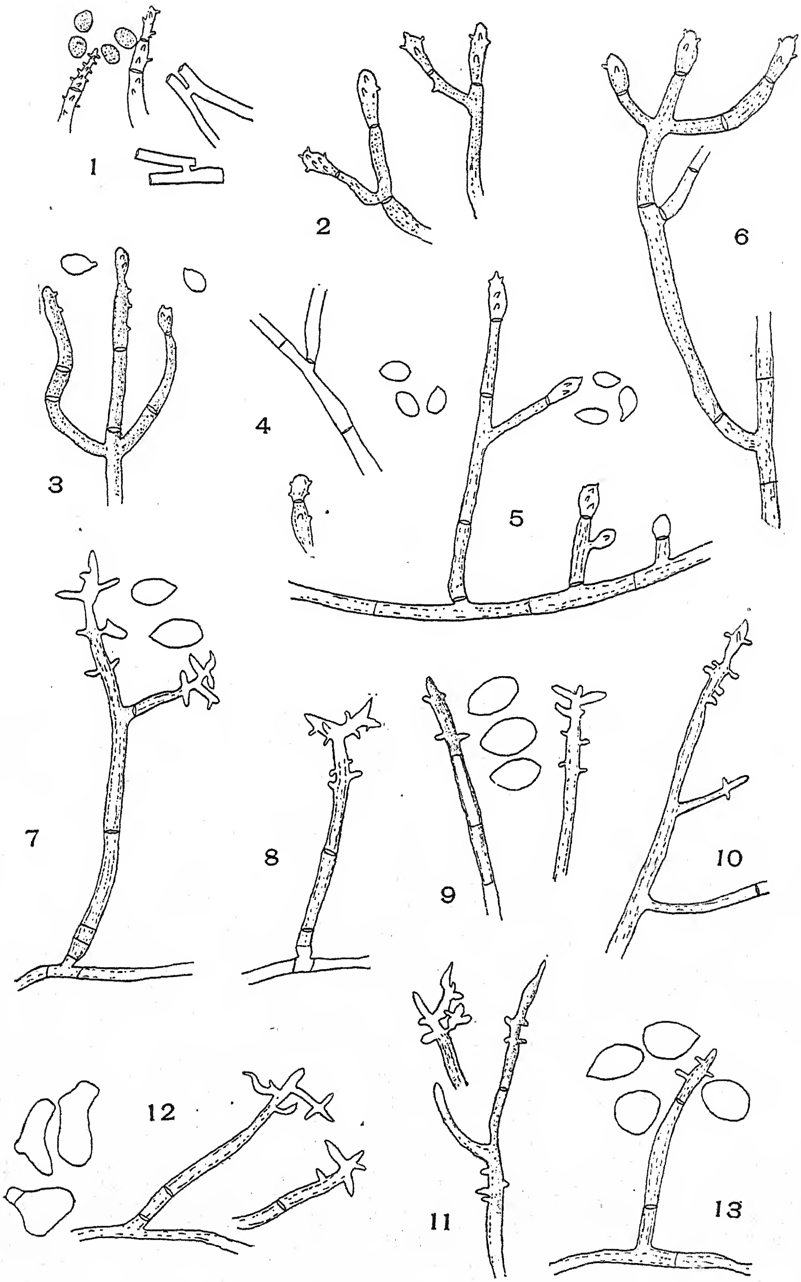
2–6. *Rhinotrichum ramosissimum* Berk. & Curt. 4, from type material.

7–11. *Olpitrichum macrosporum* (Farlow) Sumstine.

12–13. *Olpitrichum carpophilum* Atkinson. From type material.



RHINOTRICHUM



RHINOTRICHUM AND OLPITRICHUM

STUDIES IN COLORADO FUNGI—I. DISCOMYCETES

Fred J. Seaver

The present report is based on a collection of fungi made by the writer and Professor Elsworth Bethel, during a part of last August and September, in the Rocky Mountains in the vicinity of Denver. The most of the collections were made about Tolland, on the Moffat Road, at an elevation of 9,000 to 10,000 feet, at Golden, in the foothills, at an elevation of 6,000 feet, and in Geneva Creek Canyon, at elevations of 8,000 to nearly 14,000 feet.

Of a collection of 900 specimens, about 250 were included in the discomycetes. A critical study of these has revealed a number of points of interest, and, for this reason, a list of the species determined is reported in the following paper, with comments on those which are of especial interest. A number of species collected I have been unable to determine, and these are held for more critical study. Specimens of the species reported here are deposited in the herbarium of the Garden.

GEOGLOSSACEAE

Mitrula gracilis Karst. Hedwigia **22**: 17. 1883

Dr. E. J. Durand in his recent monograph of the North American Geoglossaceae (Ann. Myc. **6**: 26. 1908) records this species from Labrador and Newfoundland; he also states that the species has been reported from Greenland. Our Colorado specimens agree well in spore characters and habitat with the description given by Dr. Durand. The plants occur attached to and apparently parasitic on some species of bog moss in one of the gulches of Geneva Creek Canyon, where they were collected in quantity. *Mitrula musicola* P. Henn., which has been reported from Alberta, is said to differ only in the larger size and more convolute hymenium. More than a hundred plants were collected in Colorado and on the same host the fungus was found to vary much in size; young plants were found with a stem not over 2 mm. long

and a pileus 1 mm. in diameter, while in older plants the stem was often 2 cm. long and the pileus as large as 4 mm. in diameter, the convolutions being more marked in old than in young plants. To me it would seem doubtful if these two species can be separated on these characters. A single specimen of *Mitrula musicola* was found in the Garden collection.

MITRULA IRREGULARIS (Peck) Durand, Ann. Myc. **6**: 398. 1908

Several specimens of this species were collected at Tolland, where the plants occur on bare ground or among moss in coniferous woods. The species has formerly been reported from Ontario and New Brunswick south to the District of Columbia.

HELVELLACEAE

HELVELLA ELASTICA Bull. Hist. Champ. Fr. 299. 1791

Two plants collected among moss in Geneva Creek Canyon.

RHIZINACEAE

PSILOPEZIA BABINGTONI Berk. Outl. Brit. Fungol. 373. 1860

On rotten wood in Geneva Creek Canyon.

PEZIZACEAE

BARLAEA CONSTELLATIO (Berk. & Br.) Sacc. Syll. Fung. **8**: 111. 1889

This species was found to be very common on damp soil, both at Tolland and in Geneva Creek Canyon. The plants are bright-red and the spores smooth, with one large oil-drop often surrounded by numerous smaller ones.

BARLAEA CREC'HQUERAULTII (Crouan) Sacc. Syll. Fung. **8**: 113. 1889

Ascobolus Crec'hqueraultii Crouan, Ann. Sci. Nat. IV. **10**: 194. 1858.

Peziza modesta Karst. Myc. Fenn. **1**: 64. 1871.

Crouania asperella Rehm, Hedwigia **24**: 226. 1885.

This species was collected in Pennsylvania in 1881 and distributed by Mr. Ellis in North American Fungi *841* under the name of *Peziza modesta* Karst., which species is undoubtedly a synonym of the above. The species has also been collected and reported by the writer from Iowa. Several collections of this species

were made in Colorado, at Tolland and in Geneva Creek Canyon. The plants collected in Colorado are as large as 5 mm. in diameter, a little larger than the Iowa specimens, but spore characters are identical. Cotype material of *Crouania asperella* Rehm has been examined and found to be the same. While the species has been commonly collected and distributed in European exsiccati, the only American specimens seen, with the exception of our own collections, were those distributed by Mr. Ellis in his exsiccati. *Peziza modesta* Karst. has also been reported from Minnesota by Miss D. Hone. For diagnostic characters and illustration, see Iowa Discomycetes.

DETONIA TRACHYCARPA (Curr.) Sacc. Syll. Fung. **8**: 105. 1889

This specimen was mailed to me after returning from Colorado, having been collected by Professor E. Bethel at Lake Eldora, Sept. 17, 1910.

HUMARIA ORTHOTRICHA (Cooke & Ellis) Sacc. Syll. Fung. **8**: 119. 1889

On the ground among moss, Geneva Creek Canyon.

HUMARIA RUBENS Boud. Bull. Soc. Myc. Fr. **12**: 13. 1896

One collection in Geneva Creek Canyon.

LACHNEA MINIATA Funckel, Symb. Myc. app. **3**: 32. 1875

The species is characterized by its reticulate spores. Two collections were made in Geneva Creek Canyon.

LACHNEA SETOSA (Nees) Gill. Discom. 75. 1879

One collection on wood at Golden.

LACHNEA UMBRORUM (Fries) Sacc. Syll. Fung. **8**: 174. 1889

Abundant on soil at Tolland and in Geneva Creek Canyon. Similar in general appearance to *L. scutellata* but spores very rough, verrucose.

OTIDEA LEPORINA (Batsch) Fuckel, Symb. Myc. 229. 1869

One collection at Tolland.

PEZIZA CUPULARIS L. Sp. Pl. ed. 2. 1651. 1763

Common on the ground in coniferous woods at Tolland and in Geneva Creek Canyon.

PEZIZA BADIA Pers. Obs. Myc. **2**: 78. 1799

On soil and rotten wood in Geneva Creek Canyon.

PEZIZA BRUNNEO-ATRA Desm. Ann. Sci. Nat. II. **6**: 244. 1836

On soil in Geneva Creek Canyon.

SARCOSPHAERA ARENOSA (Fuckel) Lindau in E. & P. Nat. Pfl. **1**^{1}: 182. 1897

Two collections on sandy soil in Geneva Creek Canyon.

SPHAEROSPORA TRECHISPORA (Berk. & Br.) Sacc. Michelia **1**: 594. 1879

On soil in Geneva Creek Canyon. The spores in this species are figured by Massee as being reticulate. I can find no reticulations although the spores are coarsely verrucose. Our specimens conform well with European specimens studied but the spores are slightly larger, reaching a maximum size of 26 μ in diameter, being much smaller, however, before reaching maturity. No other American specimens have been seen.

ASCOBOLACEAE

ASCOPHANUS CARNEUS (Pers.) Boud. Ann. Sci. Nat. V. **10**: 250. 1869

Cultivated on horse dung from Tolland.

ASCOPHANUS ARGENTEUS (Curr.) Boud. Ann. Sci. Nat. V. **10**: 245. 1869

Cultivated on cow dung from Geneva Creek Canyon.

ASCOPHANUS CINEREUS (Crouan) Boud. Ann. Sci. Nat. V. **10**: 249. 1869

Cultivated on horse dung from Tolland.

ASCOPHANUS MICROSPORUS (Berk. & Br.) Phill. Brit. Discom. 307. 1887

Cultivated on rabbit dung from Geneva Creek Canyon.

ASCOBOLUS IMMERSUS Pers. Obs. Myc. **1**: 35. 1796

Cultivated on cow dung from Geneva Creek Canyon and horse dung from Tolland.

ASCOBOLUS STERCORARIUS (Bull.) Schröter in E. & P. Nat. Pfl. 1: 198. 1897

Cultivated on cow dung from Geneva Creek Canyon and Tolland.

Ascobolus xylophilus sp. nov.

Plants gregarious, sessile, 1–2 mm. in diameter, dark-colored, blackish to the naked eye, reddish-brown with the lens; hymenium slightly concave or nearly plane; asci large, cylindric or clavate, $175–235 \times 30–35\ \mu$, operculate, 8-spored; spores 1-seriate or partially 2-seriate above, large, ellipsoid, with ends narrowed, purple, at first smooth, becoming slightly roughened, $35–38 \times 13–15\ \mu$.

On the weathered surface of some coniferous wood, Geneva Creek Canyon, September, 1910.

Two species of *Ascobolus* are reported by Saccardo on pine wood: *Ascobolus lignatilis* Albert. & Schw. and *Ascobolus denudatus* Fries. Our species is very different from either, both in gross and spore characters. This is, so far as we can find, the only North American species of the genus reported on wood, most of the species occurring on the dung of animals.

LASIOBOLUS EQUINUS (Müll.) Karst. Act. Soc. Faun. Fl. Fenn. 2: 122. 1885

On cow dung and horse dung from Tolland.

RYPAROBIUS CRUSTACEUS (Fuckel) Rehm, Ber. Naturh. Ver. Augsburg **26**: 17. 1881

Cultivated on rabbit dung from Geneva Creek Canyon.

RYPAROBIUS PACHYASCUS Zukal; Rehm, Hedwigia **27**: 167. 1888

Cultivated on horse dung from Tolland.

RYPAROBIUS SEXDECIMSPORUS (Crouan) Sacc. Syll. Fung. **8**: 541. 1889

Cultivated on cow dung from Geneva Creek Canyon.

SACCOBOLUS KERVERNI (Crouan) Boud. Ann. Sci. Nat. V. **10**: 229. 1869

On cow dung from Geneva Creek Canyon.

SACCOBOLUS NEGLECTUS Boud. Ann. Sci. Nat. V. **10**: 231. 1869

Cultivated on horse dung from Geneva Creek Canyon.

HELOTIACEAE

CHLOROSPLENIUM AERUGINOSUM (Oeder) De Not. Comm. Critt. Ital. **1**: 376. 1864

Only the stained wood of this species was collected by Professor Bethel, at Tolland, so that the identity of the species is uncertain.

HELOTIUM CITRINUM (Hedw.) Fries, Summa Veg. Scand. 355. 1849

Common on rotten wood, Tolland and Geneva Creek Canyon.

?HELOTIUM POPULINUM Fuckel, Symb. Myc. 316. 1869

The plants referred to this name are very minute and bright lemon-yellow, at least in fresh specimens, and occur in abundance on decaying leaves of *Populus tremuloides*. Fuckel's species is described as subfuscous and we are therefore in doubt as to the identity of our plants.

HELOTIUM SULPHURATUM (Schum.) Phill. Brit. Discom. 161. 1887

Common in Geneva Creek Canyon on dead spruce branches partially buried in the ground. Similar to *Helotium citrinum*.

DASYSCYPHA ARIDA (Phill.) Sacc. Syll. Fung. **8**: 455. 1889

Peziza arida Phill. Grevillea **5**: 117. 1877.
Lachnum Engelmanni Earle, Pl. Baker. **1**: 25. 1901.
Dasyscypha fuscosanguinea Rehm, Ascom. 112; Ber. Naturf. Ver. Augsburg **26**: 30. 1881.

This species was originally described from material collected in Blue Canyon, Sierra Nevada Mountains, California, by Harkness and Moor. The type has not been seen but a specimen in the herbarium of the New York Botanical Garden collected by Dr. Harkness in Blue Canyon, California, has been examined and our Colorado specimens conform well with this. Dr. Rehm (l. c.) states that this species is a variety of *Dasyscypha fuscosanguinea* Rehm. So far as we can see they are identical but inasmuch as Dr. Rehm's specimens were distributed without a description we cannot do otherwise than accept the name published by Phillips. Numerous specimens were collected at Tolland and in the Geneva Creek Canyon and at first referred to *Lachnum Engelmanni* Earle, which species was later found to be identical with that of Phillips.

The species appears to be common and widely distributed, specimens having been examined from California, Colorado, Montana, Oregon, Washington, and Newfoundland, occurring on dead branches of pines and spruces.

Dasyscypha chlorella nom. nov.

Lachnum viridulum Massee & Morgan; Morgan, Jour. Myc. 8: 187. 1902. ?Not *Dasyscypha viridula* (Schrad.) Sacc. Syll. Fung. 8: 437. 1889.

The type of *L. viridulum* has not been seen, but our specimens conform well with a colored drawing made from the type by Massee, as well as with the original description. A specimen collected at Tolland seems to conform with the one collected in Geneva Creek Canyon except that the plants have faded to nearly white.

LACHNELLA CORTICALIS (Pers.) Fries, Summa Veg. Scand. 365. 1849

Common on bark, more rarely on decorticated wood at Golden and in the Geneva Creek Canyon. The species is very variable, the spores being clavate or fusiform, often as long as 26 μ and with 1–3 delicate septa. *Lachnella canescens* Cook; Phill. Brit. Discom. 259 appears to be identical.

LACHNELLA FLAMMEA (Albert. & Schw.) Fries, Summa Veg. Scand. 365. 1849

Peziza flammea Albert. & Schw. Consp. Fung. 319. 1805.
Dasyscypha allantospora Earle, Pl. Baker. 2: 5. 1901.
Lachnella rhoina Earle, Pl. Baker. 2: 6. 1901.

Very common on dead twigs of various kinds at Tolland and in the Geneva Creek Canyon. The types of *Dasyscypha allantospora* and *Lachnella rhoina* have been examined and found to be rather faded specimens of the above. The spore measurements of the latter species given by Professor Earle are too small.

LACHNELLA RESINARIUS (Cooke & Phill.) Phill. Brit. Discom. 242. 1887

Specimens collected at Tolland conform fairly well with the original description of this species. The plants occur on the bark of some conifer and somewhat resemble *Lachnellula chrys-*

ophthalma, but are smaller, a little less hairy, and the spores are very different, being ellipsoid or allantoid, while in the latter species they are globose.

LACHNELLULA CHRYSOPHTHALMA (Pers.) Karst. Medd. Soc. Faun. Fl. Fenn. 11: 138. 1884

This is one of the most common species of cup-fungi on conifers in the canyons of the mountains, both at Tolland and at Geneva Creek, and being rather large and bright-colored, is easily detected. Our plants compare very favorably with European exsiccati and although common in the Rocky Mountains, no American specimens could be found in our collections at the New York Botanical Garden.

MOLLISIACEAE

MOLLISIA CINEREA (Batsch) Karst. Myc. Fenn. 1: 189. 1871

One collection on old wood near Tolland.

ORBILIA VINOSA (Albert. & Schw.) Karst. Myc. Fenn. 1: 101. 1871

On old wood in Geneva Creek Canyon.

ORBILIA FLEXUOSA Grossl. Grevillea 22: 44. 1893

On old wood in Geneva Creek Canyon.

PSEUDOPEZIZA MEDICAGINIS (Lib.) Sacc. Malpighia 1: 455. 1886

Abundant on leaves of alfalfa at Golden.

PATELLARIACEAE

PATELLARIA ATRATA (Hedw.) Fries, Syst. Orb. Veg. 113. 1825

On old wood in Geneva Creek Canyon.

CENANGIACEAE

CENANGIUM POPULNEUM (Pers.) Rehm in Rabenh. Krypt. Fl. 1: 220. 1896

Common on *Populus tremuloides* in Geneva Creek Canyon.

Godronia Betheli sp. nov.

Ascomata erumpent through the outer bark of the host, single or occurring in clusters, often so numerous as to form congested masses many cm. in diameter and almost entirely surrounding the branches on which they grow; individual ascomata at first nearly

globose, opening at the top so as to leave an irregular margin, at maturity about 1 mm. broad and the same in height, brownish and furfuraceous externally, hymenium freely exposed at maturity, whitish or bluish-white; asci clavate, $130 \times 7\text{–}8\,\mu$, 8-spored; spores in a fascicle in the ascus, subfiliform, tapering toward either end, sharp-pointed, $65\text{–}85\,\mu$ long and $3\text{–}4\,\mu$ thick at the broadest point, becoming 7-septate at maturity and often slightly constricted at the septa, hyaline; paraphyses abundant, filiform.

On the branches of some species of willow, Tolland, August, 1910.

STICTIDACEAE

CRYPTODISCUS ATRO-CYANEUS (Fries) Sacc. Syll. Fung. **8**: 670. 1889

Very common on old wood of *Populus tremuloides,* Geneva Creek Canyon, Golden and Tolland.

Ocellaria ocellata (Pers.)

Peziza ocellata Pers. Syn. Fung. 667. 1801.
Ocellaria aurea Tul. Fung. Carp. **3**: 129. 1865.
Dermatea inclusa Peck, Ann. Rep. N. Y. State Mus. **30**: 62. 1878.
Dermatea macrospora Clements, Bull. Torrey Club **30**: 87. 1903.

The plants are erumpent but do not rise much above the surface of the bark. Very common on willow about Tolland. Fungi Columbiani *1918*, issued as *Dermatea inclusa* Peck, is identical with our Colorado specimens and so far as we can judge from the description Dr. Peck's species is identical with the above.

PROPOLIS FAGINEA (Schrad.) Karst. Myc. Fenn. **1**: 244. 1871

Propolis versicolor Fries, Summa Veg. Scand. 372. 1849.

On old wood, Tolland.

STICTIS RADIATA (L.) Pers. Obs. Myc. **2**: 73. 1799

On old wood, Geneva Creek Canyon and Tolland.

HYPODERMATACEAE

HYPODERMA LINEARE (Peck) Peck; Thüm. Myc. Univ. 1073. 1878

Rhytisma lineare Peck, Ann. Rep. N. Y. State Mus. **25**: 100. 1873

Abundant on leaves of *Pinus* sp. in the vicinity of Tolland.

This species is characterized by its peculiar spores which appear like two spores united by a very narrow neck.

LOPHODERMIUM ARUNDINACEUM (Schrad.) Chev. Fl. Par. **1**: 435. 1826

One specimen collected at Tolland on the stems of some grass.

HYSTERIACEAE

HYSTERIUM COMPRESSUM Ellis & Ev. Jour. Myc. **8**: 69. 1902

On old wood in Geneva Creek Canyon.

HYSTEROGRAPHIUM MORI (Schw.) Rehm, Ber. Nat. Ver. Augsburg **26**: 90. 1881

Collected on old wood at Berkeley by Professor E. Bethel.

HYSTEROGRAPHIUM VULVATUM (Schw.) Rehm, Ascom. *315*.

On old wood at Golden and Tolland.

NEW YORK BOTANICAL GARDEN.

CULTURES OF SOME HETEROECIOUS RUSTS

W. P. Fraser

A region to the north of Pictou, Nova Scotia, offered such excellent conditions for the study of many of the rusts that have a *Peridermium* for their aecial stage, that recently some time has been spent in their field study and a few cultures have been undertaken. In this region there are extensive areas of young coniferous woods with abundant growth of *Ledum, Pyrola, Vaccinium, Rhododendron, Rubus, Myrica,* and *Chiogenes,* and older and more dense woods with the same species. A large area of swamp also occurs with *Chamaedaphne* and other bog plants. This region, which comprises several square miles, produced many rusts, the following, as well as a number of others, being collected: *Melampsoropsis Pyrolae, M. ledicola, M. Cassandrae, M. abietina, Pucciniastrum pustulatum, P. arcticum, P. Pyrolae, P. minimum, P. Myrtilli, Calyptospora columnaris,* and *Cronartium Comptoniae. Peridermium balsameum, Per. decolorans, Per. columnare, Per. Peckii, Per conorum-Piceae, Per. consimile, Per. elatinum,* and *Per. abietinum* were also common.

Sowings were made on the various species of *Picea* used in the culture experiments by first placing the leaves bearing telia in a moist chamber, usually over night, until the teliospores had germinated. These leaves were then suspended over the young trees so that the basidiospores would fall on the young leaves of the spruces, and the whole was then covered with a belljar, usually for two days.

The young trees of *Picea* were obtained after the teliospores had begun to germinate in the open, but they were selected some distance from any source of infection. A considerable quantity of earth was removed with the roots and they were then placed in pots. Trees of about six to fifteen inches in height were selected, and to prevent excessive transpiration a few branches were removed. The experiments were carried on in a well-lighted

laboratory of Pictou Academy, no culture room being available. It is hoped that the experiments may be repeated and extended next spring.

The writer wishes to acknowledge with deepest gratitude invaluable suggestions and assistance rendered by Dr. J. C. Arthur, without which the cultures would probably not have been undertaken. The writer's thanks are also due to Mr. John Macoun, of the Geological Survey of Canada, for determining some of the host plants.

MELAMPSOROPSIS CASSANDRAE (Peck & Clinton) Arthur

The uredinial stage of this rust was collected on *Chamaedaphne calyculata* (L.) Moench in a large swamp during the summer of 1909. The host plants were kept under observation during the next spring for the purpose of collecting the telial stage. It was found in June in several places in the swamp and always on plants growing beside *Picea*. The teliospores were first noticed germinating on June 13 and they continued to germinate for some time in moist weather. Leaves bearing mature telia were collected and sowings were made on young trees of *Picea rubra* (DuRoi) Dietr. on June 17. Pycnia appeared on June 29, followed by aecia in a short time. Four plants were used and each sowing was successful. The infection was marked, and was most abundant just below where the telia-bearing leaves had been suspended. Two trees obtained in the same place as those used in the experiment were kept as controls and they remained free from aecia. The aecia were found on examination to be *Peridermium consimile* Arth. & Kern.

The spruces in the swamp near which the telia were found were watched for the appearance of aecia. Both pycnia and aecia developed abundantly and in such a position as to leave little doubt that the infection came from the telia on *Chamaedaphne*. Collections were made on July 17 and 24. On the latter date the aecia were mature. Part of the collection of July 17 was sent to Dr. Arthur for determination. He replied that it was *Peridermium consimile* Arth. & Kern and the host *Picea rubra* (DuRoi) Dietr.

Clinton (Rep. Conn. Agric. Exper. Sta. **6**: 386. 1908) sowed

the spores of *Peridermium consimile* on *Chamaedaphne calyculata* and the uredinial stage of *Melampsoropsis Cassandrae* appeared. This seems to be the only previous attempt to establish the connection of these forms.

MELAMPSOROPSIS ABIETINA (Alb. & Schw.) Arthur

The uredinial stage of this rust was very common on *Ledum groenlandicum* Oeder in the summer of 1909, and many collections of aecia were made on the spruces near, which seemed to belong to the form on *Ledum,* but as no telia were collected the connection appeared doubtful. The next spring telia were found to be very common on the under side of small, thin leaves of *Ledum,* from which the tomentum was absent. The teliospores were germinating freely the second week of June, the first collection being on June 10. At this time the young shoots of *Picea rubra* and *P. mariana* were opening, those of *P. canadensis* having opened about a week earlier.

On June 16 sowings were made on *Picea rubra* (DuRoi) Dietr. Pycnia appeared abundantly on June 25 and abundant aecia soon followed. Four trees were used and the infection was pronounced on all of them. The aecia were found on examination to be *Peridermium abietinum* (Alb. & Schw.) Thüm. Two plants of *Picea* obtained in the same place as those used for the cultures were kept as controls and remained free from aecia.

In the field, pycnia and aecia developed on the spruces that grew near the telia-bearing *Ledum.* This was observed in many places, though sometimes *M. ledicola* was near and a possible source of infection. In one place where there was abundant germination of the telia of *M. abietina* and no other rust was in the vicinity, the aecial infection on the spruces near was very pronounced. A collection from this source was made on July 17 and part of it was sent to Dr. Arthur. He reported the collection as *Peridermium abietinum* (Alb. & Schw.) Thüm. and the host as *Picea rubra* (DuRoi) Dietr.

All the forms of this rust are very common in the vicinity of Pictou. The telial stage was often found occurring on the same plants as *M. ledicola,* but was much more common than that species.

MELAMPSOROPSIS LEDICOLA (Peck) Arthur

Peridermium decolorans Peck was found to be very common on *Picea*, especially on *Picea canadensis* (Mill.) BSP., during the summer of 1909. In the spring of the following year the *Ledum* plants that were near the trees so richly infected by *Per. decolorans* were kept under observation and telia were found germinating about the first of June. The telia were then quite conspicuous on the upper surface of the leaves.

On June 7 sowings were made on four young trees of *Picea canadensis*. Pycnia were evident on June 19 and aecia followed in a short time. All the plants developed pycnia and aecia, but the infection was sparing on two of them and pronounced on the others. The aecia were determined as *Peridermium decolorans* Peck. Two plants of *Picea canadensis* from the same place as those used in the cultures were kept as controls and remained free from aecia.

The young shoots of *Picea canadensis* were just opening as the telia of *M. ledicola* began to germinate in the field and not until a week or ten days later did the buds of *P. rubra* and *P. mariana* open. This may account for the *Peridermium* being much more common on *Picea canadensis* than on the other species.

The trees of *Picea canadensis* that grew beside the rusted *Ledum* developed pycnia and aecia very abundantly; the trees nearest showed the richest infection, the aecia gradually diminishing as the trees became more distant from the *Ledum* rust. A collection of the aecia was sent to Dr. Arthur, and was determined as *Peridermium decolorans* Peck. During the summer several collections of *P. decolorans* were made, and in every case *Ledum* plants were found near, the leaves of which showed the spots where the telia of *M. ledicola* had germinated in the spring.

The aecia on *P. canadensis* were shedding spores by July 5. A few collections of aecia were made on *P. mariana* during the summer.

MELAMPSOROPSIS PYROLAE (DC.) Arthur

Rostrup has suggested that *Peridermium conorum-Piceae* (Reess) Arth. & Kern is the aecial stage of this rust. Arthur and Kern (Bull. Torrey Club **33**: 432. 1906) state that the

geographical distribution of the form on *Pyrola* would favor this assumption. As the uredinial and telial stages were very common on *Pyrola americana* Sweet and *P. elliptica* Nutt., their development was watched during the spring and early summer of last year, and the cones of the spruces in the vicinity were also kept under observation for evidence bearing on these suggestions.

By May 7 many of the uredinia were mature and the spores were escaping. The telia were first noticed germinating on May 20, and by May 23 germination was general. At this time the young pistillate cones of *Picea canadensis* were open and in a few days those of *P. rubra* and *P. mariana* were in the same condition. By the first of June the teliospores had pretty well germinated and no germinating material could be found on June 10. The cones of the spruces in the vicinity were closely watched for the appearance of pycnia. Their first appearance, as indicated by the yellow color of the scales, was on June 21, and by July 4 they were common. Owing to my absence, the place could not be visited again until July 17, when it was found that the aeciospores of *Peridermium conorum-Piceae* were being shed very abundantly from the cones of *Picea mariana* in the vicinity of the rusted *Pyrola* plants. The cones of the young trees that were easily accessible were found to be generally infected, and many of the cones on the larger trees were also infected. The *Peridermium* is conspicuous at this time, and the aecia-bearing cones could be seen at a considerable distance. As far as was observed the *Peridermium* was confined to the vicinity of the *Pyrola* plants that bore germinating telia in the spring.

The field evidence strongly supported the view that these forms are connected, and tends to confirm the statement of Arthur and Kern (l. c.) that the *Peridermium* is common though not often collected.

CALYPTOSPORA COLUMNARIS (Alb. & Schw.) Kuehn

A collection of the aecial stage of this rust was reported from Pictou last year (Science **30**: 814. 1909). It was then found to be generally distributed but rather sparingly developed in any place. Observations were begun earlier in the spring of 1910 and well developed aecia were collected on June 21. The aecia

soon became common, and in shaded places where the form on *Vaccinium* was near, were abundant and rather conspicuous on the young host plants, *Abies balsamea* (L.) Mill. It would seem that the collections of last year were made after the period of greatest abundance was past. Collections were made at other places in the province, and the aecial stage is probably common everywhere.

PERIDERMIUM BALSAMEUM Peck

This form is very common on its host throughout this province. It was found so often associated with *Pucciniastrum arcticum* (Lagerh.) Tranz. on *Rubus idaeus* var. *aculeatissimus* (C. A. Mey.) Regel & Tiling, that it pointed strongly to their connection. *Pucciniastrum pustulatum* and *P. minimum* are also common but there was no evidence of their connection with the *Peridermium*.

UROMYCES PECKIANUS Farlow

This rust was found common on *Distichlis spicata* (L.) Greene around the border of a small inlet of the harbor. Aecia were collected in several places in May on *Atriplex patula* L. and in each case the telia of *Uromyces Peckianus* were found close beside the infected plants. The aecia were very abundant, and examination showed that the teliospores of the *Uromyces* had germinated. The evidence of connection was so strong that it was decided to try a culture. Telial material had been collected from the same place in the spring and was available for use. This material was placed in a moist chamber and gave excellent germination. Plants of *Atriplex* were obtained at the seashore, as far removed as possible from the rusted *Distichlis*, and were placed in pots. Telial material was placed in a moist chamber over night when it was found to be germinating. The teliospores were then transferred with a knife to the leaves of the *Atriplex*, and the plants were covered with a belljar for a day or two. The sowing was made on May 21. Pycnia were noticed on the plants in one of the pots on June 4, but they probably appeared earlier. Aecia developed in a short time. The infection was rather sparing, only about half a dozen spots with aecia appearing altogether. The second pot of plants showed no infec-

tion, but the plants did not flourish. A pot of *Atriplex* obtained at the same place as the others was kept as a control; it remained free from aecia.

A number of plants of *Atriplex* had also been transferred to the garden outside. A sowing was made on these by germinating the teliospores in a moist chamber, and suspending the *Distichlis* leaves bearing them so that the basidiospores would fall on the *Atriplex* plants; the whole was then covered with a belljar for about two days. This sowing was made on May 28 and on June 11 abundant pycnia were noticed, which probably appeared before that date, as the plants were not carefully watched. Aecia began to form in abundance but they were eaten out of the leaves, probably by insect larvae or slugs. The experiment was carried on outside.

The infection was so marked that it left little doubt that the forms were connected, and to establish this another experiment was tried in the laboratory. Plants of *Atriplex* were obtained as before; also a number of flourishing young plants of *Chenopodium album* L. from a waste heap. Sowings were made on these on June 12 by suspending above them *Distichlis* leaves bearing telia that had been germinated in a moist chamber. The whole was then covered as usual with a belljar for a day or two. The plants were carefully watched and pycnia became evident on June 21 and were soon followed by abundant aecia. The infection was very marked on both the *Atriplex* and *Chenopodium,* but especially so on the latter, where the aecia frequently formed rows on the leaves corresponding to the *Distichlis* that had been suspended above. No aecia developed on the plants in the field around those that had been used for the experiments, and controls of *Atriplex* remained free from infection. Some of the *Atriplex* plants used in the experiments were matured and were found to be *Atriplex patula* var. *hastata* (L.) Gray.

Collections of aecia were made on *Salicornia europea* L. and *Suedia maritima* (L.) Dumort, which, from their association with the telia on *Distichlis,* seemed to be also connected. A sowing was tried on *Salicornia,* but without result. The plants, however, did not flourish and it may have been on that account that there

was no infection. The field evidence went to show that *Salicornia,* if connected, was not readily infected.

Arthur has shown by numerous experiments that *Puccinia subnitens* Diet., also on *Distichlis spicata,* has its aecia on *Chenopodium* and *Atriplex* as well as on a number of other plants. These experiments show that *Uromyces Peckianus* has similar aecial hosts.

PICTOU ACADEMY,
PICTOU, N. S.

THE PERSONAL FACTOR IN MUSHROOM POISONING

John Dearness

It is an old saying that what is one man's meat is another man's poison. Doubtless every reader has a few acquaintances whose dietetic idiosyncrasies are matter of remark among their friends. I happen to know two persons who are made ill by eating cake or other food containing egg,—never by eating eggs themselves, because neither could be bribed to taste them willingly. Not a few have to pay the penalty of total abstinence from some delicacy for having once indulged in a surfeit of it. Possibly the majority of us have discovered some generally wholesome article of diet which it is prudence on our part to avoid.

One of the theories offered to explain some of these vagaries of digestion is that many kinds of food, particularly those for which a taste has to be acquired, contain substances—call them poisons if you like—which our leucocytes have to learn to neutralize. Another theory is that in the chemical laboratory of the digestive system there are made a great variety of compounds; in exceptional cases or under exceptional circumstances, some of these may be poisonous enough to cause auto-intoxication. The imagination, too, sometimes exercises a remarkable influence upon the digestive organs. Workers in a logging camp are not apt to be squeamish. I knew of a case where one of a number of them who had just disposed very acceptably of a deep pie, on being informed of the kind of meat it contained, was immediately seized with violent *mal de mer*.

In Dr. Murrill's "Poisonous Mushrooms," Mycologia **2**: 255–264, the statement recurs, in effect if not in words, "harmless to some, poisonous to others." The question naturally arises why such opposite effects as nutrition and poison from so many species of one group of plants. Inquiry into the causes may be regarded as practical in view of the fact that there are easily ten

times as many people interested in mycophagy as in scientific mycology.

By way of drawing attention to the subject, rather than of throwing light upon it, I beg to cite three types of instances of alleged mushroom poisoning which I have had the opportunity to investigate:

A. A fellow-citizen dined on a quart of common mushrooms (*Agaricus campestris*) that he had purchased at a fruit stall. Within twelve hours he was ill enough to have a physician called, who pronounced his case one of toadstool poisoning. His recovery was complete in two or three days.

B. Near a neighboring town a man collected "a basketful" of supposed mushrooms. His wife was suspicious of them, with the consequence that the collector cooked and ate them without assistance. Before morning he was "sick enough to die," but the promptitude of the doctor "saved his life."

C. A week of wet, warm weather early in May had brought up in a thinly wooded pasture an abundant crop of helvellas (*Gyromitra esculenta*). Two or three families in the neighborhood collected them for food. One of the families, on a Tuesday evening, ate about two quarts of them, the method of preparation being frying in butter. On the next day at noon a smaller quantity—about a quart and a half—was similarly disposed of. That night every member of the family was taken ill, and on Friday one of them, in spite of the efforts of two physicians, passed into a comatose condition which terminated in death. The others recovered without medical treatment.

The explanation given out in case A was that there "must have been a toadstool among the mushrooms." It is not improbable that wholesome fungi have been blamed for the faults of bad company. In this instance, however, examination of specimens from the basket out of which the quart had been taken revealed a thorough infestation of larvae. Half the quantity of as wormy mutton might have produced worse effects. The limit of edibility of a fungus is reached by the time its "worminess" shows tunnels that can be detected with the unaided eye.

In case B the offender proved to be *Lepiota naucinoides*. The victim assured me that he had admitted no other kind to his

basket; indeed, that he had been "very particular to gather only fresh, clean specimens." While I suspect that this beautiful and highly commended toadstool is slightly poisonous, I believe that had the consumer under notice made its acquaintance more gradually he might have brought himself to eat "three platefuls of it" with safety. When we consider that, properly remorseful for scouting his wife's advice, he imagined that he had eaten a potful of deadly toadstools, we cannot wonder that his overloaded stomach made him feel sick enough to die.

C. Both terms of the binomial *Helvella esculenta*, suggest eating—wholesale and wholesome. Some European mycophagists have written commendations of this fungus. Berkeley's reference to its edibility is tempered with the caution that it is unsafe for some persons, a circumstance dependent rather on a peculiarity of the person's constitution, than upon some deleterious quality of the plant. The personal equation does not seem wholly sufficient to explain the history of the cases cited under C. *Helvella esculenta*, or *Gyromitra* as it is now called, cannot be mistaken for any other species, hence the variously toxic effects referred to may all be surely ascribed to the fungus named. These did not appear, it is needless to say, and were not suspected, after the first meal. Yesterday, they seemed nutritious or at least innocuous; to-day, they are poisonous to the same persons. In view of all that I could learn, it seemed more probable that the poison developed in the collected fungi than that it was started during their digestion. For a genuinely fleshy fungus, *Gyromitra* is not readily putrescible. Specimens taken from the same ground lay on my table a week or more without any sign of change save shrinkage in volume.

The heavy sickening odor given off by *Amanita phalloides* and *A. verna* in drying is well known. In the slow relaxation by moist air in a closed vessel of well-dried specimens of *Helvella crispa*, *Boletus Clintonianus*, and *Agaricus silvicola*—three species named in the edible lists—I have observed the development of a similar odor. The odors may not have any connection with the deadly alkaloid present in the *Amanita*, but they are evidence of some similar chemical change.

Among the unstable nitrogen compounds present in some of

the fungi, I can conceive that decompositions may take place that are not evident as putrescence, resulting in poisonous compounds. Such changes might be arrested or facilitated by the conditions in the alimentary canal and become effective inversely as the vigor and rapidity of the digestive process. If there is any truth in this speculation, then it follows that a person who may have eaten without injury any of those species characterized as "harmless to some, poisonous to others" at one time, might be poisoned by the same species at another time.

In the process of disintegration, nocuous products undoubtedly do develop from innocent compounds, but, further, it is quite conceivable that the strength of poisonous principles may vary in the same species of mushroom or that even some alkaloid may be normally present in one set of conditions and be absent in another. On what other theory can one explain the experience reported by Dr. Cleghorn in the October number of *Good Housekeeping?* *Coprinus comatus* ranks very near the common meadow mushroom in general popularity, and in the literature of mycophagy it is usually spoken of with unqualified commendation, yet here is an experience in a neighborhood where the shaggy-mane was "formerly eaten with pleasure" in which ten persons in four different families were made so ill as to require medical aid. The symptoms as reported by Dr. Cleghorn are interesting enough to repeat. In some cases these appeared in a few minutes after eating, in others after several hours. They exhibited a well-marked intoxication, with failure of muscular coordination, blood-shot, dilated eyes, incoherent speech, and drowsiness, but without depression of the action of heart and lungs.

The variability of the effects produced by eating mushrooms or toadstools raises a number of very interesting questions, the consideration of which from any point of view increases the sense of responsibility attendant upon recommending almost any of these plants as articles of diet to the uninitiated.

LONDON, ONTARIO,
CANADA.

THE AGARICACEAE OF TROPICAL NORTH AMERICA—II

WILLIAM A. MURRILL

The genera treated in the present paper show a strong contrast to most of those in the first article of this series, both as to the number of species found in our tropics and the general information regarding them. This is chiefly due to the fact that tough forms growing on wood above ground are better adapted to tropical conditions than fleshy forms, especially the larger ones, growing in the soil, where air is scarce and bacteria and moulds abound in the rainy season, and where extreme conditions of heat and dryness prevail during the dry season. The fleshy forms are also difficult to collect and preserve, and require good field notes to make them really valuable for study.

These genera are all abundantly represented in temperate regions, some of the species being the most common ones found in our forests, but tropical conditions appear to offer an almost impassable barrier to them, *Lepiota* alone excepted. The following simple key shows how these genera may be readily distinguished.

Volva and annulus both present. 1. LEUCOMYCES.
Volva alone present. 2. VAGINATA.
Annulus alone present.
  Lamellae free.
    Spores hyaline, tinged with brown in a few species.
      Pileus dry, usually scaly. 3. LEPIOTA.
      Pileus viscid, smooth. 4. LIMACELLA.
    Spores green when fresh, brown in herbarium specimens. 5. CHLOROPHYLLUM.
  Lamellae attached.
    Stipe fleshy. 6. POLYMYCES.
    Stipe cartilaginous. 7. CHAMAEMYCES.

1. LEUCOMYCES Batt. Fung. Hist. 27. 1755

Venenarius Earle, Bull. N. Y. Bot. Gard. 5: 450. 1909.

This genus includes the species usually known under the name *Amanita,* which name is properly a synonym of *Agaricus,* as

pointed out by Earle. The separation of *A. muscaria* and related species into the genus *Venenarius* is hardly practical, since the form of the basal volva is not constant in either of the two genera thus separated.

Leucomyces mexicanus sp. nov.

Pileus convex, regular, 5 cm. broad; surface milk-white, smooth, dry, with satiny luster, adorned with patches of the membranous volva, which are 2–3 mm. broad, thin, white, separable; margin thin, entire, concolorous; context thin, white, odor distinct, pleasant; lamellae white, remote from the stem, arcuate, narrow, crowded; spores oblong, smooth, hyaline, 4–5 × 2 μ; stipe cylindric, equal, white, hollow, glabrous, 4.5 cm. long, 4 mm. thick, not swollen at the base; annulus superior, membranous, ample, white, movable; volva white, circumscissile, the basal portion small, collapsed, and scarcely noticeable.

Type collected on rich earth in a moist virgin forest near Motzorongo, Mexico, 400 meters, January 15, 1910, *W. A. Murrill 1067.*

This species resembles *Lepiota* more than it does most species of *Leucomyces,* but it has a distinct volva and the pileus shows separable volval patches. The odor is pleasant, suggesting *Trametes suaveolens,* though not so distinct.

2. VAGINATA (Nees) S. F. Gray, Nat. Arr. Brit. Pl. 1: 601. 1821

Amanitopsis Roze, Bull. Soc. Bot. Fr. 23: 50. 1876.

This genus differs from *Leucomyces* chiefly in lacking a veil, although both genera have the sheath, or volva, at the base of the stipe.

Vaginata vaginata (Bull.)

Agaricus vaginatus Bull. Herb. Fr. *pl. 98.* 1782.

This species, so abundant in temperate regions, probably occurs sparingly in the northern Bahamas and in the high mountains of our tropics. The Bahamian material, collected by Mr. Nash, is pressed flat and is without notes, except that the color was white and no ring was observed. Two specimens collected by myself at Chester Vale, Jamaica (No. 351), at an elevation of over 3,000 ft., agree very well with the small, murinous, temperate form of this species, but the base of the stipe and volva were, unfortu-

nately, decayed when the plants were found. However, there are large patches on the surface of the pileus which indicate that most of the volva was carried up by it in developing, leaving very little at the base. No attempt is made to cite here the synonyms of this species.

3. LIMACELLA Earle, Bull. N. Y. Bot. Gard. 5: 447. 1909

This genus differs from *Lepiota* chiefly in having a smooth, viscid pileus instead of a dry and scaly one, as is well illustrated in one of the best known species, *L. illinita*.

Limacella agricola sp. nov.

Pileus convex, regular, rather firm for the genus, 2.5 cm. broad; surface smooth, glabrous, slimy, white, with incurved, striate margin; lamellae free, white, broad, unequal; spores subglobose, smooth, pure hyaline, often uninucleate, 4–5 μ long; stipe cylindric, even, white, glabrous, shining, slightly bulbous at the base, 2.5 cm. long, 2 mm. thick; annulus superior, slight, evanescent.

Type collected on the lawn at Constant Spring Hotel, near Kingston, Jamaica, December 20, 1909, *W. A. & Edna L. Murrill.*

4. LEPIOTA (P. Browne) S. F. Gray, Nat. Arr. Brit. Pl. 1: 601. 1821

This genus is based on the well-known "parasol mushroom" of temperate regions, *Lepiota procera*. The species seem well adapted to tropical conditions, possibly owing to their loose texture and their choice of humus or well-drained locations. For present purposes, the various genera recognized by Earle, *Cystoderma, Fusispora, Mastocephalus,* and *Lepiota,* are all kept together. The following artificial grouping of the species here treated is given for the convenience of the student:

Pileus small, 3 cm. or less broad.	
Pileus white or whitish, the umbo usually differently colored.	1–5.
Pileus some shade of red.	6–7.
Pileus some shade of gray or brown.	8–11.
Pileus medium or large, 4 cm. or more broad.	
Pileus white or yellowish, the umbo often differently colored.	12–17.
Pileus some shade of red.	18.
Pileus brown.	19.

1. **Lepiota lactea** sp. nov.

Pileus thin, convex, slightly umbonate, solitary, 1–1.5 cm. broad; surface white, smooth, slightly silky, especially near the

margin; lamellae free, crowded, rather broad, plane, white; spores ovoid, regular, smooth, hyaline, $5 \times 3.5\,\mu$; stipe white, hollow, subglabrous, tapering upward from an enlarged base, 4 cm. long, 2–5 mm. thick; annulus large, white, persistent, near the middle of the stipe.

Type collected on the ground in a banana field at Santiago de las Vegas, Cuba, June 17, 1904, *F. S. Earle 75*. This species is related to *L. colimensis*, but is quite distinct.

2. **Lepiota colimensis** sp. nov.

Pileus convex, regular, solitary, not umbonate, 1.5 cm. broad, 5 mm. high; surface dry, white, delicately floccose, not scaly, the center concolorous; lamellae free, white; spores broadly fusiform, smooth, pure hyaline, $7–8 \times 3.5–4.5\,\mu$; stipe long, slender, white with an avellaneous tint, cepaeform at the base, 4 cm. long, 2 mm. thick above, 7 mm. thick below; annulus superior, large, white, persistent, apparently fixed.

Type collected on the ground in an orchard at Colima, Mexico, 500 m., January 3, 1910, *W. A. & Edna L. Murrill 618*. A small specimen of what appears to be the same species was collected in a moist forest at Motzorongo, Mexico, 400 m., January 15, 1910, *W. A. & Edna L. Murrill 1023*.

3. **Lepiota tepeitensis** sp. nov.

Pileus convex to expanded, slightly umbonate, 3 cm. in diameter; surface white, uneven, fuliginous at the center, adorned with fuliginous, imbricate scales, the remains of the cuticle; lamellae free, white, broad, rather crowded; spores ellipsoid, smooth, pure hyaline, usually uninucleate, $7 \times 4\,\mu$; stipe white, glabrous, tapering upward, 4 cm. long, 3 mm. thick; annulus slight, evanescent.

Type collected in humus in a moist virgin forest along the Tepeite River, near Cuernavaca, Mexico, 2300 m., December 28, 1909, *W. A. & Edna L. Murrill 522*. The general appearance of the plant suggests *Lepiota ianthina* Cooke, first found in greenhouses at Kew Gardens, but the disk and its radiations are fuliginous instead of dark-violet.

4. **Lepiota flavodisca** sp. nov.

Pileus thin, conic to subexpanded, the center remaining conic in form, solitary, 2 cm. broad; surface white, minutely crested, long and deeply striate, becoming plicate on drying, the center flavous,

subglabrous to granulose; lamellae white, free, rather crowded; spores ovoid, smooth, hyaline, uninucleate, 5–7 × 3–4 μ; stipe slender, enlarged and flavous at the base, hollow, minutely tomentose, 3 cm. long; annulus slight, evanescent.

Type collected in Bermuda grass sod at Santiago de las Vegas, August 1, 1904, *F. S. Earle 139*. A colored sketch by Mrs. Earle has proved valuable in drawing the description.

5. **Lepiota subcristata** sp. nov.

Pileus convex, umbonate, solitary, 7.5 mm. broad, 5 mm. high; surface floccose, pale-isabelline, with dark-avellaneous, imbricated scales, the umbo smooth, purplish-fuliginous; lamellae free, white; spores ellipsoid, smooth, hyaline, 5 × 3 μ; stipe slender, equal, glabrous, purplish-fuliginous, 1.5 cm. long, 1 mm. or less thick; annulus slight, evanescent.

Type collected on rotten wood near Moore Town, Jamaica, 200 m., December 16, 1908, *W. A. & Edna L. Murrill 158*. What appears to be the same species, though there are no field notes, was collected by W. E. Broadway in August and September, 1905, at The Bower, St. George's, Grenada. In one of these collections, the sporophores measure over 1 cm. in diameter, in the other, about 5 mm.

6. **Lepiota testacea** sp. nov.

Pileus conic, truncate, regular, 4 mm. broad, 2 mm. high, solitary; surface smooth, pale-testaceous, covered with fine tomentum, margin fibrillose; lamellae free, white, ventricose, broad; spores ovoid, smooth, hyaline, uninucleate, 7 × 3.5–4 μ; stipe cylindric, enlarged at the base, glabrous, white, 1 cm. long, scarcely 1 mm. thick; annulus superior, large, persistent, white, fixed by the lower margin.

Type found growing in rich soil on a damp, shaded bank near Chester Vale, Jamaica, 1,000 m., December 22, 1908, *W. A. & Edna L. Murrill 355*. Also collected on the same day in a nearby locality, *W. A. & Edna L. Murrill 401*. The relationship of this species is with *L. rubrotincta*. It is such a tiny plant that it is easily overlooked.

7. **Lepiota subgranulosa** sp. nov.

Pileus hemispheric, 1 cm. broad, 5 mm. high, solitary; surface testaceous, finely granulose, adorned with minute, conical tufts

of fibrils; lamellae free, narrow, close, white to stramineous; spores ellipsoid, smooth, hyaline, a few distinctly uninucleate, not apiculate, $7 \times 3.5\,\mu$; stipe testaceous, fibrillose, cylindric, equal, not enlarged at the base, rose-colored at the apex, 1.5 cm. long, 2 mm. thick; annulus testaceous, superior, very close to the lamellae, fixed by the lower margin, the free limb narrow and perpendicular to the stipe.

Type collected in coffee plantations at Xuchiles, near Cordoba, Mexico, 500 m., January 17, 1910, *W. A. & Edna L. Murrill 1146.*

8. **Lepiota Broadwayi** sp. nov.

Pileus expanded, regular, scarcely umbonate, about 3 cm. broad; surface dry, subglabrous, striate, avellaneous, fuliginous at the center, the cuticle remaining almost unbroken; lamellae free, white, broad, unequal; spores perfectly globose, hyaline, smooth, $5\,\mu$; stipe 3 cm. long, 3 mm. thick, enlarged above, hollow, glabrous, whitish; annulus white, ample, superior, persistent, apparently fixed.

Type collected on the ground between roots of trees in Hyde Park, St. George's, Grenada, August 27, 1905, *W. E. Broadway.*

9. **Lepiota subgrisea** sp. nov.

Pileus small, convex to expanded, slightly umbonate, gregarious, 1–1.5 cm. broad; surface avellaneous, adorned with imbricated scales arranged in a somewhat radiate manner from the glabrous, fuliginous umbo; lamellae free, white, of medium breadth and distance; spores ellipsoid, smooth, hyaline, uninucleate, apiculate, $7 \times 3.5–4\,\mu$; stipe white, glabrous, slightly tapering upward, 1.5 cm. long, 1–2 mm. thick; annulus slight, evanescent.

Type collected near the coast west of Port Antonio, Jamaica, December 18, 1908, *W. A. & Edna L. Murrill 246.* Also collected at Moneague, Jamaica, January 17, 1909, *W. A. & Edna L. Murrill 1135.* This species is closely related to *L. fulvaster,* from South Carolina.

10. **Lepiota aspratella** sp. nov.

Pileus expanded, often becoming depressed, somewhat umbonate, gregarious, 1–2 cm. broad; surface yellowish-brown, thickly studded with small, granular, somewhat conical warts, which are slightly browner than the rest of the surface; lamellae free, white, much crowded, rather broad, ventricose; spores ellipsoid or ovoid, smooth, hyaline, $5 \times 3.5\,\mu$; stipe curved, usually equal, concolor-

ous, floccose-scaly over its entire surface, 2–3 cm. long, 1.5–3 mm. thick; annulus not distinct.

Type collected on a much decayed log in an orange grove at Chester Vale, Jamaica, 1,000 m., December 23, 1908, *W. A. & Edna L. Murrill 379*. Also collected at Chester Vale, *W. A. & Edna L. Murrill 389*. This species is closely related to *Lepiota asprata*, described by Berkeley from South Carolina, but the surface covering is very distinct.

11. **Lepiota rimosa** sp. nov.

Pileus convex to expanded, umbonate, gregarious, 1–2 cm. broad; surface smoky-fuliginous, paler with age, faintly striate, often splitting from the margin, covered with a granular coating which cracks areolately with age exposing the white flesh; lamellae free, crowded, very broad, somewhat ventricose, white; spores subglobose or broadly ovoid, smooth, hyaline, 4 μ long; stipe cylindric, white, subglabrous, 2–4 cm. long, 1–2 mm. thick; annulus small, white, persistent, about the middle of the stipe.

Type collected on the ground in a garden at Santiago de las Vegas, Cuba, June 19, 1904, *F. S. Earle 110*. This is possibly the plant reported from Cuba by Berkeley and Curtis as *L. floralis*, a species described from South Carolina.

12. LEPIOTA CRISTATA (Bolt.) Quél. Champ. Jura Vosg. 34. 1872

Agaricus cristatus Bolt. Hist. Fung. Halifax **1**: *7. pl. 7.* 1788.

Agaricus subantiquatus Batsch, Elench. Fung. **2**: *59. f. 205.* 1789.

This well-known temperate species was collected in coffee plantations near Cordoba, Mexico, and in orchards at Colima, Mexico. This tropical form is smaller and much paler than the form commonly seen in the United States and Europe, and the scales on the pileus are comparatively inconspicuous, but it probably does not merit specific distinction. The margin becomes yellow when bruised.

Mexico, *W. A. & Edna L. Murrill 602, 1138*.

13. LEPIOTA LONGISTRIATA Peck, Bull. Torrey Club **25**: 368. 1898

This species, described from plants collected by Earle in gardens in Alabama, is whitish, with brown umbo, hairy-squamulose, and

marked with very long striations. The Cuban specimens mentioned below were found in gardens and on a lawn, while the Jamaica collection was made in woods.

Santiago de las Vegas, Cuba, *Earle 290, 362, 531;* Port Antonio, Jamaica, *Earle 602.*

14. **Lepiota cretacea** (Bull.)

Agaricus cretaceus Bull. Herb. Fr. *pl. 374.* 1787. (Type from France.)

Agaricus luteus With. Bot. Arr. 3: 344. 1792. (Type from England.)

Agaricus cepaestipes Sowerby, Eng. Fungi *pl. 2.* 1797. (Type from England.)

Agaricus (Lepiota) sordescens Berk. & Curt. Jour. Linn. Soc. **10**: 283. 1868. (Type from Cuba.)

Agaricus (Lepiota) cheimonoceps Berk. & Curt. Jour. Linn. Soc. **10**: 283. 1868. (Type from Cuba.)

Lepiota cepaestipes Quél. Champ. Jura Vosg. 35. 1872.

Lepiota farinosa Peck, Ann. Rep. N. Y. State Mus. 43: 35. 1890. (Type from Massachusetts.)

?*Lepiota Magnusiana* P. Henn. Hedwigia **31**: 318. 1892. (Type from Germany.)

Lepiota mammaeformis Underw. Bull. Torrey Club **24**: 82. 1897. (Type from Alabama.)

This edible, cosmopolitan species occurs in attractive and conspicuous groups or clusters, the pileus being white, or rarely yellow, and the base of the stipe usually swollen like a young onion. The mealy or warty covering over the entire sporophore strongly suggests *Amanita solitaria* and *A. echinata.* The spores are ovoid or ellipsoid, often pointed at one end, smooth, hyaline, usually uninucleate, 8–11 × 5–7 μ. *Hiatula squamulosa* Mont., described from Guiana, resembles this species, but the spores are described as ovoid-reniform. *Agaricus apodactylus* Berk. & Curt., from Cuba, is not distinct, but this is probably only a manuscript name.

Cuba, *Earle 15, 16, 547, 559, 28, 113, 52, 550, 301;* Grenada, *Broadway;* Guadeloupe, *Duss;* Santo Domingo; Nicaragua, *Oersted.* Also in the United States, South America, Europe, and the Orient.

15. LEPIOTA SUBCLYPEOLARIA (Berk. & Curt.) Sacc. Sylloge Fung. **5**: 67. 1887

Agaricus (*Lepiota*) *subclypeolarius* Berk. & Curt. Jour. Linn. Soc. **10**: 283. 1868. (Type from Cuba.)

The rather poorly preserved types of this species, as well as other specimens at Kew from tropical America, resemble *L. cretacea,* but the spores are very different, being broadly ellipsoid, smooth, hyaline, averaging $6 \times 4.3\,\mu$, and not showing a large nucleus as in that species.

16. LEPIOTA HEMISCLERUS (Berk. & Curt.) Sacc. Sylloge Fung. **5**: 66. 1887

Agaricus (*Lepiota*) *hemisclerus* Berk. & Curt. Jour. Linn. Soc. **10**: 283. 1868. (Type from Cuba.)

The types at Kew, collected by Wright, are well preserved, showing the small, rigid, conical warts on the pileus very distinctly. The spores are said to be narrowly oblong, smooth, hyaline, $11\,\mu$ long. These latter, with the warts on the pileus, strongly suggest *L. cretacea.*

17. **Lepiota jamaicensis** sp. nov.

Pileus 10 cm. in diameter, convex to plane, with a prominent hemispherical umbo, cespitose on dead wood, the entire sporophore becoming reddish-brown when bruised or on drying; surface dry, white or very pale yellowish, adorned with brownish, floccose scales 1 mm. broad, the remains of the cuticle; umbo brown, minutely scaly; context thin, white; lamellae free, white, becoming discolored when the spores mature; spores ovoid, rounded at both ends, not apiculate, often uninucleate, very pale brown, $9 \times 6–7\,\mu$; stipe enlarged at the base, tapering upward, 10 cm. or more long, 1.7 cm. thick below, 0.7 cm. thick above, subglabrous, slightly reddish-brown; annulus large, superior, movable, reddish-brown.

Type collected on a hardwood stump in a cocoanut plantation near Manchioneal, Jamaica, at an elevation of about 100 m., December 17, 1908, *W. A. Murrill 181.*

This plant closely resembles *Lepiota americana* Peck, a well-known temperate species, both in shape and color, but grows in dense clusters on dead wood, has decidedly browner spores, and much smaller scales on the pileus, as well as a minutely scaly

umbo. Its affinities are evidently with *Lepiota,* although the spores are not altogether hyaline.

18. LEPIOTA RUBROTINCTA Peck, Ann. Rep. N. Y. State Mus. 44: 67. 1892

Agaricus rubrotinctus Peck, Ann. Rep. N. Y. State Mus. 35: 155. 1884. (Type from New York.)

Mastocephalus carneo-annulatus Clements, Bot. Survey Neb. 4: 17. 1896. (Type from Nebraska.)

This very beautiful species occurs occasionally at several points in our tropics, from sea-level up to 2,000 ft., and more frequently in the United States, at various elevations, the spores as well as the sporophore showing considerable variation. It also very probably ranges southward into South America under forms represented by *L. carminea* Pat. and *L. erythrella* Speg. *L. purpureoconia* Atkinson seems hardly sufficiently distinct. I am indebted to Dr. Peck for the determination of specimens from Louisiana.

Bahamas, *Brace 4815;* Cuba, *Britton & Wilson 398, 400;* Jamaica, *Earle 505, Murrill & Harris 867;* Honduras, *M. E. Peck.* Also in the United States.

19. **Lepiota abruptibulba** sp. nov.

Pileus fleshy, rather thin, 6–7 cm. broad, hemispheric to subexpanded, at first umbonate, at length obtuse; surface rich reddish-brown, the cuticle breaking into minute, floccose-granular scales, not striate, darker on the umbo; lamellae white, free, crowded, unequal, rather broad; spores subglobose to ovoid, smooth, hyaline, tinged with brown, 5–5.5 $\times$ 4 μ; stipe cylindric, subglabrous, tinged with reddish-brown, hollow, 7 cm. long, 6 mm. thick, the base swollen into an abrupt, flattened bulb; annulus large, persistent, superior, movable.

Type collected on the ground in a banana field near Santiago de las Vegas, Cuba, June 18, 1904, *F. S. Earle 94.* Also collected in the same locality in June and September, *F. S. Earle 67, 167;* and in thickets near Candelaria, Cuba, *F. S. Earle 209.* The description is mainly drawn from Professor Earle's excellent field notes.

5. CHLOROPHYLLUM Mass. Kew Bull. 135. 1898

This genus was separated from *Lepiota* on the basis of the green color of its fresh spores, with *C. esculentum* as its type and *C. Morgani* and *C. Molybdites* as additional species. We now know that these three names all refer to the same plant, which ranges from Brazil northward through the United States. The European species, *Schulzeria Eyrei* Mass., also has green spores, but no annulus.

The green color in the spores of *Chlorophyllum* seems to disappear rather quickly on drying, leaving the spores pale-brown, so that herbarium specimens are usually referable to the genus *Agaricus*, although otherwise resembling *Lepiota*. In describing *Agaricus guadelupensis*, Patouillard remarks that it is exactly intermediate between *Agaricus* and *Lepiota*, the spores being too pale for the former genus and too dark for the latter.

A dozen or more of the Boletaceae, among them several of our commonest species, have spores that are greenish or olivaceous when fresh, fading to brownish on drying, but in none is the green color so pronounced as in *Chlorophyllum*.

CHLOROPHYLLUM MOLYBDITES Mass. Kew Bull. 136. 1898

Agaricus Molybdites Mey. Fl. Esseq. 300. 1818. (Type from Guiana.)

Pholiota Glaziovii Berk.; Warming, Symb. Fl. Bras. 32. 1878. (Type from Brazil.)

Agaricus Morgani Peck, Bot. Gaz. 4: 137. 1879. (Type from Ohio.)

Lepiota ochrospora Cooke & Mass. Grevillea **21**: 73. 1893. (Type from Guiana.)

Chlorophyllum esculentum Mass. Kew Bull. 136. 1898. (Type from Guiana.)

?*Agaricus guadelupensis* Pat. Bull. Soc. Myc. Fr. **15**: 197. 1899. (Type from Guadeloupe.)

This very large and attractive species, found in pastures and cultivated grounds, is of unusual interest on account of its green spores. It is used for food in many places, but is poisonous to some persons, though never fatal. It was first described from Guiana by Meyer, and was known to Fries through Lund's col-

lections in Brazil. Berkeley assigned the name *Pholiota Glaziovii* to specimens collected near Rio Janeiro, Brazil. Specimens collected by Jenman in British Guiana were named *Lepiota ochrospora,* owing to the fact that the spores in dried specimens appeared ochraceous by transmitted light. Other specimens collected at the same time by Jenman in pastures near the coast received the name of *Chlorophyllum esculentum,* because the gills were observed to turn green at maturity and the plant was known to be edible. Even in poorly preserved specimens, it is readily recognized by its peculiar spores, which are ovoid, smooth, pale-brown in herbarium material, apiculate, $7–9 \times 5–6\,\mu$, at times slightly larger, especially in fresh specimens.

Cat Island, Bahamas, *Britton & Millspaugh 5862;* Jamaica, *Earle 439, Underwood 3482;* Grenada, *Broadway;* Trinidad; British Guiana; Brazil. Also in New Jersey, North Carolina, Alabama, Louisiana, Mississippi, Texas, Ohio, Indiana, Kansas, Colorado, Nebraska, Michigan, Wisconsin, and Iowa.

6. POLYMYCES Batt. Fung. Hist. 34. 1755

Armillariella Karst. Acta. Soc. Faun. Fl. Fenn. **2**: 4. 1881.

POLYMYCES CINEREUS Batt. Fung. Hist. 34. 1755

Agaricus melleus Vahl, Fl. Dan. 9. *pl. 1013.* 1792.

Agaricus polymyces Schw. Schr. Nat. Ges. Leipzig **1**: 80. 1822.

Agaricus (Armillaria) melleorubens Berk. & Curt. Jour. Linn. Soc. **10**: 283. 1868. (Type from Cuba.)

Armillaria mellea Quél. Champ. Jura Vosg. 38. 1872.

This is a very important tree parasite in temperate regions, and is also much used for food. In the tropics, it is evidently not thoroughly at home, having been found by our collectors only at Mooretown, Jamaica, and at Jalapa, Mexico. For a description and a colored illustration of this species, see MYCOLOGIA **1**: 2.

Cuba, *Wright 45;* Jamaica, *Earle 560, W. A. & Edna L. Murrill 168;* Mexico, *W. A. & Edna L. Murrill 21, 25, 136.*

DOUBTFUL SPECIES

Armillaria umbilicata Pat. Bull. Soc. Myc. Fr. **15**: 191. 1899. Described from plants collected by Duss in Guadeloupe.

7. CHAMAEMYCES Batt. Fung. Hist. 32. 1755

Mucidula Pat. Hymén. Eur. 95. 1887.

This genus, founded on the species commonly known as *Armillaria fracida* Fries, differs from *Polymyces* chiefly in its subcartilaginous stem, the adnate gills being hardly distinctive in this instance.

Chamaemyces alphitophyllus (Berk. & Curt.)

Agaricus (*Amanita*) *cubensis* Berk. & Curt. Jour. Linn. Soc. **10**: 282. 1868. (Type from Cuba.)

Agaricus (*Armillaria*) *cheimonophyllus* Berk. & Curt. Jour. Linn. Soc. **10**: 284. 1868. (Type from Cuba.)

A. (*Mycena*) *alphitophyllus* Berk. & Curt. Proc. Am. Acad. **4**: 112. 1860. (Type from the Bonin Islands.)

A. (*Mycena*) *leucoconis* Berk. & Curt. Proc. Am. Acad. **4**: 113. 1860. (Type from the Bonin Islands.)

This interesting species, easily identified by its immense globose spores, 16 μ or more in diameter, is common on exposed hardwood logs and decayed spots in standing trunks throughout the lowlands of Cuba, Jamaica, and Guadeloupe, and also occurs in Louisiana, Mexico, and elsewhere in our tropics. The only collection made above 2,000 ft. seems to have been at Jalapa, Mexico, at an elevation of 5,000 ft. Earle found it common on willow in one of the parks at New Orleans in August, 1908. It was first described from the Bonin Islands, and, according to Patouillard, it also occurs in Tonkin.

Cuba, *Wright, Earle 38, 112, 151, 267, 376, 294, 268, 150, 278, Baker 262, Underwood & Earle 420, 1137, 1112;* Honduras, *M. E. Peck;* Mexico, *W. A. & Edna L. Murrill 166, 1071;* Jamaica, *Earle 263, 562, 573, Underwood 3339, W. A. & Edna L. Murrill 120, 124, 828, Murrill & Harris 1067, 1075, E. G. Britton 996;* Guadeloupe, *Duss;* Grenada, *Broadway;* Montserrat, *Shafer 875;* Louisiana, *Earle 12;* Bonin Islands, *Wright.*

NEW YORK BOTANICAL GARDEN.

NEWS AND NOTES

Professor A. H. Graves, of the Yale Forestry School, visited the Garden on February 14 to consult the collections with reference to the diseases of certain forest trees.

Dr. J. J. Davis, of Racine, Wis., an authority on parasitic fungi, has been appointed curator of the herbarium of the University of Wisconsin. The botanical collections will be provided with ample quarters in the new biological building.

Although several articles have appeared in Mycologia containing Latin diagnoses, contributors are requested to use English for this purpose, because it makes better reading, saves time and trouble both to the author and publisher, and is fully as valid for the publication of new species.

"*Shade-Trees in Towns and Cities,*" by William Solotaroff, just published by Wiley & Sons, New York, gives directions for the treatment of the principal fungous diseases of shade-trees. The work also contains many other things of interest to the tree lover, presented in attractive form and abundantly illustrated.

In "*Notes on Chilean Fungi—I*" (Bot. Gaz. 50: 430–443. 1910), Dr. Roland Thaxter describes and illustrates the following new species of fungi: *Taphrina entomospora, Uncinula Nothofagi,* and *Uncinula magellanica,* all of which occur on living leaves of *Nothofagus antarctica.*

In Sweden, where the eating of mushrooms is very general, species having the "death-cup," or volva, are held in great respect, only two of these, *Amanita rubescens* and *Amanitopsis vaginata,* being considered safe by the ordinary collector.

Professor Bruce Fink has recently made a very important contribution to lichenology in the form of a large illustrated bulletin

from the United States National Museum on the lichens of Minnesota, which presents the results of many years of study in this interesting but difficult field.

In the *Botanical Gazette* for January, Professor G. F. Atkinson discusses the origin and taxonomic value of the "veil" in *Dictyophora* and *Ithyphallus*, concluding that the two genera should remain distinct and that *Phallus Ravenelii* Berk. & Curt. should remain in *Ithyphallus*, where it was placed by Fischer.

Several inquiries have been made regarding the colored charts of edible and poisonous mushrooms mentioned in MYCOLOGIA for November. The French charts, by Mazimann & Plassard, are out of print; the Swedish charts, four in number, accompany Lindblad's *Svampbok*, price 6 kr., which may be obtained through Mr. Lars Romell, Brahegatan 51, Stockholm, Sweden.

"*Minnesota Mushrooms*," by Professor F. E. Clements, recently published by the Geological and Natural History Survey of Minnesota, is a handy and attractive volume of 170 pages, 124 figures, and 2 plates, designed for use in the high schools and colleges of the state and distributed to them practically free of charge. The author has not attempted to incorporate into this work the advances made in classification during the last twenty years, so pupils may readily refer from it to the works of Saccardo, Peck, and others from which it is mainly compiled.

The first number of "*Phytopathology*," the official organ of the American Phytopathological Society, appeared in February, 1911, and future numbers will appear regularly in alternate months. As its name implies, this periodical is devoted primarily to the publication of articles dealing with plant diseases, a subject of immense importance and one which is receiving much attention throughout the country. This number contains 38 pages and 5 plates, the first being a portrait of Anton De Bary, a distinguished German phytopathologist of the latter half of the past century, whose career forms the subject of the opening article. Succeeding articles deal with clover rusts, crown gall, fig diseases, floret sterility in wheat, blackleg of cabbage, fruit-spot of apple, and a book review. Professor Jones and his associates are to be con-

gratulated upon the attractive appearance and interesting contents of this number.

The difficulty of mounting agarics for the herbarium in such a way as to prevent them from being crushed, while economizing space and maintaining a single series, is recognized by every mycological curator. In many herbaria, it is still the practise to press all specimens flat and glue them to the sheet or enclose them in packets; in others, a separate box collection is kept for the larger specimens, and, when a specimen is wanted, there is much confusion and noise before it is found and finally returned to its proper place in the sequence. At the New York Botanical Garden, several devices have been tried with more or less success, the chief objects being to preserve the specimens and to arrange them, with all notes and drawings, in one series.

For large specimens, boxes of different sizes are used, and these are placed in light trays made of tulip wood, or glued to cardboard cut to fit the pigeonholes of the herbarium cases. Small specimens are placed in pill-boxes or similar thin boxes specially designed, which are enclosed in packets, a safer and better way than fastening them directly to the sheet. A very convenient arrangement for special or odd sizes is a small open box with cardboard bottom and sides of cypress or white pine or cork strips attached with glue, which box is enclosed in a packet. This device is excellent for microscopic slides, which also properly belong in the herbarium series with the specimens.

The older mycologists mounted their specimens so that they might readily be seen as the sheets were turned, a method with obvious advantages, but, unfortunately, very destructive to the specimens. A rather expensive substitute for this method is the use of envelopes with transparent fronts and boxes with glass or celluloid tops, which might at least be employed for sample sets of species to be used for ready reference in the identification of new material.

All specimens, however mounted, should be inspected at least once a year, and a small quantity of naphthalene flake added to the boxes or packets in which they are kept in order to prevent invasion by insects. Suggestions from other curators will be welcomed.

Miss A. C. Atwood, Cataloguer, Bureau of Plant Industry, Washington, D. C., contributes the following:

"In the course of my work I have chanced upon several rather important errors in Lindau & Sydow's *Thesaurus Litteraturae Mycologicae et Lichenologicae* to which the attention of users of this work ought to be called.

In vol. 1, p. 377, are several references credited to Alb. H. Dietrich: the first, no. 80, should be credited to Dietrich, Albert, (1795–1856) and the others no. 81–83, to Dietrich, Heinrich August.

In vol. 2, p. 42, a large number of references are credited to Elie Marchal: nos. 11–24, 32, should be credited to Marchal, Elie; nos. 31, 33–56 to Marchal, Emile. No. 38 is a wrong reference, no such article appearing in vol. 20 of Rev. Mycol., it is probably the same as no. 25a.

Under Cornu, Maxime, vol. 1, p. 311, no. 77 is a reference to *Comptes Rendus* XC, 1880, p. 357, which would seem to indicate that the article appeared in this volume of the *Comptes Rendus;* the fact is, however, that p. 357 contains only a note of the reading of the article, which never appeared in the *Comptes Rendus.*

I have spent some time in trying to locate this article and think it may, perhaps, be worth while to record here the information which I have gathered in regard to it. It appeared in a work published under the auspices of the Paris Academy under the title *Observations sur le phylloxera.* Paris, 1881. Cornu's part in this work was entitled *Études sur les peronosporées* and the article *Le meunier, maladie des laitues* &c. forms part I of this. In a note, Cornu states that brief resumés of this memoir were published in the *Comptes Rendus* v. 87, p. 801–803 and p. 916–919, from which we may infer that these two articles *Maladies des laitues nommée le meunier* (Lindau, v. 1, p. 311, no. 60) and *Maladies des plantes déterminées par le Peronospora* (Lindau v. 1, p. 311, no. 61) formed the basis for his later article. *Études sur les peronosporées II. Le peronospora des vignes* was published in 1882 by the Paris Academy, Cornu's title being used as a subtitle under the general title *Observations sur le phylloxera,* which latter is quoted by Lindau (see p. 321, no. 88). I cannot discover that these articles of Cornu appeared in any other form."

ILLUSTRATIONS OF FUNGI

MYCOLOGIA

Vol. III May, 1911 No. 3

ILLUSTRATIONS OF FUNGI—VIII

William A. Murrill

Some time in May, in this latitude, depending upon the temperature and rainfall, tiny mushrooms begin to appear on the lawns and in the fields, and many of them reappear periodically during summer and early autumn after each season of wet weather. These species, as a class, are avoided by the beginner in mycology and are puzzling even to experts. The accompanying plate illustrates a number of them, in selected genera, drawn by Mr. Volkert a year ago from the first specimens found, and reproduced natural size. Later in the season, the sporophores of some of these species tend to grow larger, owing to the increased temperature and the more active mycelium.

Inocybe infida (Peck) Earle

Unsafe Inocybe

Plate 40. Figure 1. × 1

Pileus ovoid to campanulate, at length expanded, umbonate, gregarious, 1.5–3 cm. broad; surface silky-scaly, shining, light tawny-brown, sometimes paler, dark reddish-brown on the umbo, often splitting at the margin; lamellae free, crowded, pale-yellowish to grayish-cinnamon; spores ovoid, irregular, nodulose, 10–11 × 6–7 μ; stipe subequal, concolorous, pruinose, scurfy above, 3–5 cm. long, 2–4 mm. thick; veil white, evanescent, clinging in delicate threads to the stipe and the margin of the young pileus.

[Mycologia for March, 1911 (3: 45–95), was issued March 18, 1911]

This species was first described as a *Hebeloma* by Dr. Peck, in 1874, from specimens collected on mossy ground in swampy woods in the Adirondacks. Professor Massee, in 1904, includes it in his monograph of the genus *Inocybe,* citing three European synonyms. The form so abundant on the shaded portions of the lawn in front of the museum building of the New York Botanical Garden is darker in color than any specimens previously described. The poisonous properties of this species have been discussed in MYCOLOGIA for September, 1909, and November, 1910.

Naucoria semiorbicularis (Bull.) Quél.

COMMON NAUCORIA

Plate 40. Figure 2. × 1

Pileus hemispheric to convex or rarely plane, gregarious, 2–5 cm. broad; surface glabrous, smooth, often cracking with age, slightly viscid when wet, tawny or ferruginous to paler; lamellae adnate or adnexed, broad, crowded, ferruginous; spores ellipsoid, smooth, brownish-ferruginous, 10–12 × 5–7 μ; stipe slightly enlarged at the base, rather tough, stuffed, glabrous, yellowish-brown or reddish-brown, 7–12 cm. long, 2–3 mm. thick.

This excellent edible species is common on lawns and in pastures and along roads and paths from May to November, usually appearing after periods of wet weather. The beginner will have difficulty in distinguishing it because of its homogeneous brownish colors and its lack of definite structural characters.

Omphalia Volkertii sp. nov.

VOLKERT'S OMPHALIA

PLATE 40. FIGURE 3. × 1

Pileus infundibuliform to umbilicate, tough, flexible, scattered, 1–2 cm. broad, about 7 mm. high; surface glabrous, hygrophanous, fuliginous, becoming avellaneous soon after picking; lamellae decurrent, distant, tough, discolored-avellaneous; spores subglobose, smooth, hyaline, 4 μ; stipe crooked, tapering below, concolorous, glabrous, hollow, 1.5–2 cm. long, 1–2 mm. thick.

This species was found abundant and widely scattered over a low, mossy field east of the New York Botanical Garden, on May 22, 1910, by W. A. Murrill and E. C. Volkert. It is most closely

related to *Omphalia montana* Peck, a depauperate form of *O. Gerardiana* Peck collected on Mt. Marcy.

Laccaria laccata (Scop.) Berk. & Br.

WAXY MUSHROOM

Plate 40. Figure 4. × 1

Pileus convex or plane, sometimes depressed at the center, usually gregarious, 1.5–5 cm. broad; surface glabrous or nearly so, hygrophanous, pale-red to flesh-red or darker, fading to grayish on drying, striate in certain thin varieties; lamellae broad, distant, adnate, subdecurrent, or slightly emarginate, pale flesh-red, occasionally deep-violet, dusted at maturity with the abundant spores, which are globose, roughly echinulate, 8–10 μ; stipe slender, equal, fibrous, glabrous, concolorous with the pileus, 2.5–7 cm. long, 3–6 mm. thick.

As the description indicates, this species is very variable in form, size, and color; but, after all, it is so different from most other mushrooms that it is easily recognized. It is widely distributed throughout temperate regions and is one of the most common species met with, both in woods and fields. All authors pronounce it harmless, and, although poor in quality, it is often eaten. The accompanying figure is drawn from small specimens collected in a low, shady place on a lawn. A larger species, *Laccaria ochropurpurea*, found in woods, is also edible. It differs from *L. laccata* chiefly in size and is by some considered only a variety of that species.

Psilocybe Foenisecii (Pers.) Quél.

HARVEST MUSHROOM

Plate 40. Figure 5. × 1

Pileus conic or campanulate to convex, gregarious, 1–2.5 cm. broad; surface glabrous, hygrophanous, smoky-brown or reddish-brown, paler when dry, often variegated; lamellae adnate, ventricose, not crowded, brown; spores subellipsoid, smooth, brown, 12–15 × 6–7 μ; stipe slender, equal, hollow, fragile, glabrous or slightly pruinose, pallid to brownish, 5–8 cm. long, 2 mm. thick.

The harvest mushroom is small but very abundant and may therefore be considered for use as food, although it cannot be

classed among the best species. It occurs everywhere on lawns and in fields after rains throughout the season, and should be carefully distinguished from certain poisonous species of *Panaeolus* and other genera which grow in similar localities.

Conocybe tener (Schaeff.) Fayod

Galera tener (Schaeff.) Quél.

SLENDER CONOCYBE. BROWNIE CAP

Plate 40. Figure 6. × 1

Pileus thin, conic to campanulate, 1–2 cm. broad and high; surface glabrous to slightly pubescent, tan or brownish, slightly darker at the center, hygrophanous, ochraceous when dry; lamellae adnexed, ascending, crowded, fulvous; spores ellipsoid, smooth, dark-ferruginous, $12–14 \times 6–8\,\mu$; stipe slender, equal, subconcolorous, glabrous to slightly pubescent, hollow, fragile, 7–12 cm. long, 2–3 mm. thick.

This shapely little fungus occurs everywhere on lawns and in manured pastures from spring to autumn. When once known, it is not easily confused with any other species. Although edible and well-flavored, it would take a long time to gather enough for a meal.

Panaeolus retirugis (Fries) Quél.

WRINKLED PANAEOLUS

Plate 40. Figure 7. × 1

Pileus ovoid to conic or campanulate, subumbonate, gregarious, 1–3 cm. broad; surface tan, gray, or brownish, glabrous, reticulate-rugose, especially near the center, viscid and dull-colored in wet weather, cracking in dry weather; margin appressed in young sporophores, decorated with triangular fragments of the veil at maturity; lamellae adnexed, ascending, broad, gray to black; spores ellipsoid, smooth, black, $13–16 \times 9–11\,\mu$; stipe slender, equal, hollow, pruinose, usually gray or reddish-brown, darker below, often banded with the dark spores above, 5–15 cm. long, 3–5 mm. thick; veil white, conspicuous in young stages, not forming an annulus on the stipe, but becoming appendiculate on the margin, especially in wet weather.

This attractive species is common and widely distributed in temperate regions during spring and summer on heavily manured

lawns and about dung in pastures. It is rather easily recognized by its netted and wrinkled cap and the bits of veil that hang from the margin. Although pronounced edible by all authorities, being of nutty flavor and agreeable odor, it does not appeal to mycophagists as most edible species do. Dr. W. W. Ford recently investigated this species and found an extract from it to be fatal to guinea pigs; but an extract from the famous morel, *Morchella esculenta,* was found to have a similar effect.

Collybidium dryophilum (Bull.) Murrill

Collybia dryophila (Bull.) Quél.

OAK COLLYBIDIUM

Plate 40. Figure 8. $\times$ 1

Pileus rather tough, convex to nearly plane, sometimes depressed, gregarious to subcespitose, 1–5 cm. broad; surface smooth, glabrous, dry, stramineous to fulvous or bay, margin involute when young; context thin, white, of nutty taste; lamellae adnexed or sinuate, watery-white, rarely yellowish, rather close; spores ellipsoid or ovoid, smooth, hyaline, $5–7 \times 4–5\ \mu$; stipe cartilaginous, glabrous, brown and stuffed below, pale and fistulose above, 2.5–7 cm. long, 2–6 mm. thick.

Common throughout temperate regions both in woods and pastures from spring to autumn, occurring on the ground or rarely on decayed wood. An edible species of good quality, known and used in many parts of the world. I have seen it exposed for sale in Jalapa, Mexico, in December, specimens having been brought in from the woods by the Indians. The early spring form here illustrated is about half the size of the usual summer and autumn form.

Inocybe Lorillardiana sp. nov.

LORILLARD INOCYBE

PLATE 40. FIGURE 9. $\times$ 1

Pileus subconic to convex or applanate, slightly umbonate, gregarious, 1.5–2.5 cm. broad; surface dry, yellowish-brown, conspicuously imbricate-scaly, the scales more erect on the umbo; context fleshy, thin, pale-yellow, pleasant to the taste; lamellae adnate or adnexed, numerous, unusually broad at the apex, edges

white or pale-yellow; spores oblong-ellipsoid, sometimes slightly curved, smooth, ferruginous, 8–10 × 4–5.5 μ; stipe crooked, enlarged above, cream-colored, with conspicuous tufts of ferruginous fibrils, giving it a shaggy appearance, about 3 cm. long, 2–3 mm. thick; veil slight, pale-yellowish, disappearing at a very early stage.

The plants figured, the type specimens, were found growing among mosses on the lawn adjoining the Lorillard Mansion in Bronx Park, July 3, 1910, by W. A. Murrill.

Naucoria pennsylvanica (Berk. & Curt.) Sacc.

PENNSYLVANIA NAUCORIA

PLATE 40. FIGURE 10. × 1

Pileus globose to hemispheric, subcespitose, 1–2 cm. broad; surface dry, hispid-squamulose, pale-fulvous, margin incurved, slightly appendiculate in early stages; lamellae squarely adnate, broad, ferruginous-fulvous; spores ellipsoid, often plane or concave on one side, smooth, deep-ferruginous, 7 × 4–5 μ; stipe curved, tapering upward, hollow, cartilaginous, paler than the pileus, with whitish tomentum, especially near the base, 2–3 cm. long, about 3 mm. thick; veil slight, arachnoid, disappearing at a very early stage.

This species was collected on a fallen dead log in low woods near the New York Botanical Garden, September 13, 1910; and compared at Upsala with Michener's plants from Pennsylvania. It is small, but conspicuous, and seems rather widely distributed in the northern United States.

Cyathia hirsuta (Schaeff.) White

Cyathus striatus Willd.

STRIATE CYATHIA

Plate 40. Figure 11. × 1

Peridium, or cup, obconic, open wide at the top (8–10 mm.), narrow at the base (2–4 mm.), 10–15 mm. high; outer surface ferruginous to dark-brown, shaggy; inner surface glabrous, shining, lead-colored, smooth at the base, distinctly striate-sulcate above; mouth decorated with stiff bristles at the margin, closed by a thin white membrane in young stages; sporangioles, or "eggs,"

dark-colored, 2 mm. broad, shining, somewhat angular, situated at the bottom of the cup; spores somewhat crescent-shaped, thick-walled, hyaline, 12–18 × 6–9 μ.

This tiny bird's nest fungus occurs singly or in clusters on sticks, chips, rich earth, etc., throughout the United States and south as far as Mexico, Porto Rico, and other parts of the tropics. The "eggs" fill only the lower part of the cup, or "nest," leaving the upper striated part, by which the species is readily known, exposed to view.

The family to which this species and the next belong was studied here some years ago by Miss V. S. White, who published an illustrated article on the subject in the *Bulletin of the Torrey Club* 29: 260, in which all the bird's nest fungi of North America were discussed.

Crucibulum crucibuliforme (Scop.) White

Crucibulum vulgare Tulasne

COMMON CRUCIBULUM

Plate 40. Figure 12. × 1

Peridium tough, cylindric-campanulate, truncate and slightly contracted at the base, 5–10 mm. broad and high; outer surface smooth, isabelline to fulvous, minutely velvety, glabrous and fading with age; inner surface smooth, shining, whitish; mouth entire, at first covered with a thin yellowish membrane; sporangioles 1.5–2 mm. broad, numerous, pale-ochraceous to whitish; spores ellipsoid, smooth, hyaline, 8–10 × 4–6 μ.

This species of the Nidulariaceae occurs commonly throughout temperate North America on decayed twigs, chips, trash, etc. It grows in shady places and is shaped like a cup or crucible, while the preceding species seems to prefer the open and is vase-shaped or obconic in form. Both species are tough and inedible, but not poisonous, although much too small to be considered for economic purposes.

Campanularius semiglobatus sp. nov.

HEMISPHERIC CAMPANULARIUS

PLATE 40. FIGURE 13. × 1

Pileus subhemispheric, with broad, compressed umbo, gregarious or subcespitose, 2.5–4 cm. broad; surface glabrous, smooth

or somewhat cracked, avellaneous-isabelline; lamellae adnate, broad, crowded, soon blackening; spores ovoid, very regular, smooth, black, opaque, $11–13 \times 8–9\,\mu$; stipe equal, hollow, glabrous or pruinose, concolorous above, pale-latericious below, 5–9 cm. long, 3–5 mm. thick; veil not apparent.

Type specimens were collected on manure in flower beds, in Bronxwood Park, June 20, 1910, by W. A. Murrill.

Inocybe abundans sp. nov.

ABUNDANT INOCYBE

PLATE 40. FIGURE 14. $\times$ 1

Pileus convex, rarely umbonate, gregarious, 2–4 cm. broad; surface dry, rimose-striate, silky-fibrillose, isabelline, with ferruginous hues at the center and light-brown fibrous lines radiating from it; context mild, with a rather strong fungous odor; lamellae free or adnexed, pallid to ferruginous; spores ovoid to ellipsoid in outline, irregular, roughly papillate, very pale ferruginous, $7 \times 4\,\mu$; cystidia hyaline, flask-shaped with short necks, $25 \times 15\,\mu$, stalks slender, about $20\,\mu$ long; stipe equal, pallid above, subconcolorous below, 5 cm. long, 3 mm. thick; veil white, slight, evanescent.

Exceedingly abundant in damp places in woods about New York City in late summer. A brown species not easily distinguished from *I. infelix* Peck, which latter plant has recently been discovered to be poisonous.

Inocybe Astoriana sp. nov.

ASTOR INOCYBE

PLATE 40. FIGURE 15. $\times$ 1

Pileus convex, umbonate, gregarious, 2–3 cm. broad; surface dry, rimose-striate, silky-fibrillose, avellaneous-isabelline, fuliginous on the umbo; context sweet and nutty, with the odor of musty meal; lamellae adnate, pallid to fulvous; spores irregular, roughly papillate, fulvous, ellipsoid in outline, $8–10 \times 5\,\mu$; cystidia flask-shaped with very short necks, hyaline, $35 \times 18\,\mu$; stipe subequal, pallid above, concolorous below, 3 cm. long, 3 mm. thick; veil white, fragile, evanescent.

The type specimens here figured were collected by W. A. Murrill and E. C. Volkert, September 13, 1910, growing on the ground

in damp places in woods on the Astor estate in the suburbs of New York City. They resemble *I. infida* rather closely, but differ in several important characters.

Panus stypticus (Bull.) Fries

ASTRINGENT PANUS

Plate 40. Figure 16. $\times$ 1

Pileus tough, conchate, spatulate to reniform, about 1–3 cm. broad; surface isabelline to subfulvous, nearly even, zoned at times, the cuticle breaking into granules or small scales, margin entire or lobed, incurved when young; context thin, firm, rather tough, watery-white, taste not always evident at once, but becoming strongly acrid and astringent; lamellae narrow, thin, crowded, interveined, isabelline, determinate; spores globose, smooth, hyaline, $2–4 \times 1–3\,\mu$; stipe lateral, short, swollen above, solid, compressed, pruinose, pale-isabelline or dull-white above, darker below.

This small, inconspicuous species is common throughout temperate regions during autumn and winter on stumps of deciduous trees in woods. It is phosphorescent, and also poisonous, possessing a strongly acrid and astringent taste, but it would hardly be collected for food even if well-flavored because of its small size and apparent toughness.

AMERICAN SPECIES OF ALECTORIA OCCURRING NORTH OF THE FIFTEENTH PARALLEL

R. HEBER HOWE, JR.

(WITH PLATES 41–47, CONTAINING 32 FIGURES)

While I have been pursuing an intensive study of *Usnea* and *Evernia*, the results of which have appeared in the Bulletin of the Torrey Botanical Club and the Botanical Gazette, I have also been collecting data for this review of *Alectoria*. The present paper therefore represents the work of over six years, which during the past winter I have brought into form for publication.

The genus *Alectoria* was proposed by Acharius in 1810, and was later limited by Nylander. Though Acharius included under his *Alectoria* several species now removed to other allied genera, his species cannot be considered "altogether incoherent," and the genus must be credited to him. Almost since its proposal, the question of spore-colors has led lichenologists to divide it into two taxonomic units. The argument of Tuckerman (Gen. Lich. 14–16. 1872) still holds undeniably true; while I also quite agree with Th. Fries (Lich. Scand. 19–28. 1871), and later Dr. Zahlbruckner, in the recognition of a sectional separation to distinguish species of *Alectoria* which are distinct in the number and color of their spores. Such a distinction is, however, better worthy of sectional than generic separation, and is adopted only to elucidate the problem of classification that presents itself. Stizenberger in a most valuable paper on the genus (Die Alectorienarten und ihre geographische Verbreitung, Annal. K. K. Nat. Hofmuseums, 7: 117–134. 1892) also recognized subgenera.

The following genera have included at various times species still considered in the genus *Alectoria*, though few of these names can be classed as true generic synonyms: *Lichen* L. 1753; *Usnea* Web. 1780; *Lobaria* Hoffm. 1795; *Parmelia* Ach. 1803; *Cornicularia* Ach. 1803; *Setaria* Ach. 1798, Mich. 1803; *Evernia* Fr.

1831; *Cetraria* Fr. 1831; *Bryopogon* Link 1833; *Atestia* Trevis. 1861; *Oropogon* Th. Fr. 1861; *Eualectoria* Th. Fr. 1871; and *Hyalospora, Hyalodidyma, Phaeospora* Sacc. 1882.

The genus is represented in our area throughout the Transitional and Boreal zones by at least ten distinct species.

Following each species I have appended a list of North American material examined. A large number of European specimens examined I have not thought necessary to list. To the curators of these herbaria I wish here to express my sincere thanks for the privilege of examination. The abbreviations within parentheses are used in the citation of specimens. In this practice I am following the excellent precedent set by Dr. L. W. Riddle in his recent work on the genus *Stereocaulon.*

1. Herbarium of the U. S. National Museum (NH).
2. Herbarium of Dr. J. W. Eckfeldt in the Academy of Natural Sciences, Philadelphia (ANS).
3. Herbarium of the New York Botanical Garden (NY).
4. Herbarium of Wellesley College, Massachusetts (W).
5. Herbarium of Prof. Bruce Fink, Miami University, Oxford, Ohio (F).
6. Herbarium of the Portland Society of Natural History, Maine (P).
7. The C. J. Sprague Herbarium in the Boston Society of Natural History (S).
8. The Clara E. Cummings Herbarium, Wellesley College (CEC).
9. Herbarium of the Boston Society Natural History (BSNH).
10. Herbarium of Dr. L. W. Riddle, Wellesley, Mass. (R).
11. Herbarium of the Sullivant Moss Chapter (SM).
12. Herbarium of the University of Maine, Orono, Maine (UM).
13. Taylor Herbarium, Boston Society of Natural History (T).
14. Herbarium of Dr. H. E. Hasse, Sawtelle, California (HEH).
15. Herbarium of Mr. C. C. Plitt, Baltimore, Md. (CCP).
16. Herbarium of the Carnegie Museum, Pittsburg, Pa. (CM).
17. Herbarium of Brown University, Providence, R. I. (B).
18. Herbarium of the Canadian Geological Survey, Ottawa (CGS).
19. Herbarium of Dr. A. C. Herre, Oakland, Cal. (ACH).

The author's herbarium in the Thoreau Museum of Natural History, Concord, Mass., is indicated by (H).

ALECTORIA:* Ach. pro. parte, Lich. Univ. 120. *pl. 13. f. 1–4.* 1810

"Tree-hair," "Rock-hair," "Horse-tail Lichen"

DESCRIPTION: *Apothecia* lateral, sessile, or on geniculations of the branches, appendiculate (*oregana*), scutelliform, convex, car-

* From the Greek, meaning unmarried.

tilaginous, innate-marginate, periphery entire, or fimbrio-ciliate (*oregana*), disk concolorous or discolorous, rarely pruinose. *Asci* clavate, containing 2 to 8 spores; paraphyses gelatinous, filamentous. *Spores* monoblast, hyaline or colorate, muriform or emuriform. *Spermagones* immersed or papilliform, apices slightly incrassate. *Soralia** white, pale virescent or yellow. *Soredia* unobserved. *Cephalodia* unobserved. *Cyphella* occasionally present. *Thallus* erect, prostrate, or pendulous, branched, tortulous, terete, subterete, or compressed; glabrous, nitidous, canescent, sulciform or foveolate; pale stramineous, virescent sulphureous, cinereous or brown; *cortex* cartilaginous, contiguous; gonidia "*Protococcus*" (*Cystococcus humicola* (Næg.); medulla loosely cottonous, arachnoid or absent.

Though I have examined an immense amount of material and placed it under the following species with as much accuracy as possible, judging it with the enlightenment of a long and critical study, I am not ready to claim that the distribution of specimens has been either faultless or the reason always apparent. The genus *Alectoria* presents a most complex and difficult problem, due to the enormous variation found in filamentous lichens, and, after years of study, it seems to me that we must keep the broadest view of species and allow the two extremes of variation to stand far apart. To narrow our limits, and name contingent phases that present themselves in legion, we at once destroy the discrimination which is possible to one after long study of much material.

The only determinations that I am absolutely sure of are of those specimens which I myself have gathered in the field, or that have been collected in such entirety, accompanied by careful field notes, that I can not only judge of the plant, but of its particular environs. It is a common experience of lichenists to find that a plant which has long been an absolute puzzle after the examination of much herbarium material, will be at once understood if met and studied in the field. *Alectoria divergens* with *Cetraria aculeata*, *Alectoria chalybeiformis* and its northern limit of distribution, and *Alectoria ochroleuca cincinnati* and *crinalis*, are examples of puzzles that only an extensive field study can thoroughly solve. Exactitude can never be gained by narrowing

* Bitter, Hedwigia 40: 171. 1901.

the limits of variation in this genus, and I take it that to make possible a scientific comprehension of species is one aim of systematic botany.

KEY TO THE SPECIES

A. Thallus dark (brown) throughout.
  a. Prostrate.
    Rigid.
      Unicolored. [boreal
        Stout, apices furcate, esoraliate .... *divergens*]
      Unicolored or partially bicolored. [austral to subboreal
        Stout, apices simple, soraliate .... *chalybeiformis*]
    Subrigid.
      Bicolored. [subboreal to boreal
        Slender, apices simple, esoraliate .... *bicolor*]
  b. Pendulous.
    Lax.
      Unicolored.
        Slender throughout. [transitional to subboreal
          White soraliate .... *implexa*]
        Stout, extremities capillaceous.
          White soraliate.
            Apothecial margins entire. [transitional
              Disk brown .... *jubata*]
            Apothecial margins ciliate. [alpine
              Disk brown .... *oregana*]
          Yellow soraliate.
            Apothecial margins entire. [transitional to subboreal
              Disk yellow. .... *Fremontii*]
B. Thallus light (virescent) or partially so.
  a. Erect.
    Rigid.
      Unicolored. [alpine
        Slender, apices minute .... *osteina*]
      Bicolored, darker above. [boreal
        Slender, apices livid .... *nigricans*]
        [boreal
        Stout, apices black .... *ochroleuca*]
  b. Prostrate.
    Rigid.
      Unicolored, occasionally blackening throughout.
        Stout, cavernous. [boreal
          Extremities noncapillaceous .... *cincinnati*]
  c. Pendulous.
    Subrigid.
      Unicolored.
        Slender, esulciform.
          Extremities subcapillaceous. [transitional]

Sulphurous .... *virens*]
Stout, occasionally sulciform.
Extremities capillaceous. [transitional to subboreal
Virescent .... *sarmentosa*]

SECT. I. BRYOPOGON (Link) Th. Fries, Lich. Scand. 23. 1871

Asci containing 8 hyaline spores. Thallus dark or light. Medulla cottonous.

In 1859, Tuckerman described (Amer. Jour. Sci. & Arts, 28: 203) a new *Cetraria* from California which he named after the State. This plant has been the object of much discussion, and as in the Bryologist (13: 28. 1910), during the past year, it was definitely attributed by Mr. G. K. Merrill to the genus *Alectoria,* we must consider it in the present paper. Let us follow its history chronologically. The plant was collected at Monterey by Menzies, and specimens were given to Tuckerman. The type material is in the Tuckerman Herbarium, Botanic Museum, Harvard University, Cambridge, Mass. Tuckerman's original description was as follow: "thallo caespitoso cartilagineo anguloso lacunoso-subcanaliculato opaco e viridi fusciscente ramis irregulariter subdichotome ramosis patentibus, fertilibus superne incrassatis; apotheciis terminalibus appendiculatis margine dentato-fimbriatis demum convexis nigris." This latter was translated by Mr. Merrill (Bryologist, l. c.), but he inadvertently failed to render "anguloso." Tuckerman added to his original description: "Fronds in small, roundish masses, many branches diverging from a single base, with the aspect rather of a small slender state of *Ramalina calicaris,* β, than of the erect *Cetrariae,* to which, and in particular *C. tristis* and *C. aculeata,* it is indeed, if I mistake not, nearest allied. The station, upon trees, and on the coast of California, is a very unlikely one for *C. aculeata,* from which the present also differs remarkably in habit of growth, and in color. Though more than seventy years have passed since the venerable botanist who gave me these specimens collected them, they appear to be undescribed."

In 1858–60 (Synop. Lich. 300), Nylander makes the next important reference to the species in a footnote under *C. aculeata* Fr. where he writes: "(1) Forte varietati *horrescenti* Nyl. Prod. p. 194 affinis sit *Cetraria californica* Tuck. Suppl. 2, p. 203, 'thallo

. . . nigris.' Ad corticem arborum in Monterey Californiae (Menzies). Specimen nullum vidi, et sine analysi dubium est an hujus sit loci species Tuckermaniana. Apothecia 'appendiculata' nigra genus aliud indigitare videntur."

In 1872 (Gen. Lich. 9), Tuckerman writes "*C. californica*, Tuckerm." . . . "a tree-lichen, discovered by Menzies, and looking often rather like a discoloured, small form of *Ramalina calicaris,* but in fact comparable, as respects the thallus, with *Cetraria aculeata,* and, especially as respects the apothecia, with *C. tristis,* proves also to agree with the latter in its spermogones and spermatia; and constitutes therefore a very interesting addition to our scanty material for the final determination of the place of *C. tristis*."

After ten years, in 1882 (Synop. 29), Tuckerman again lists the species, describing it as follows: "thallus tufted, fruticulose, erect, cartilagineous, subfistulous, compressed-terete, at length deeply- and canaliculate-lacunose dichotomously much- and spread-branched; greenish olivaceous, fuscescent, dull; apothecia sub-terminal, middling-sized, appendiculate, the disk dark-green, becoming convex and black, and excluding the toothed margin. Spores ellipsoid $\frac{6-9}{3-4}$ mic.—Spermogones immersed-papillae-form; spermatia oblong, thickened at each end $\frac{4-5}{1-1\frac{1}{2}}$ mic." It will be noticed that the most important additions are the words "compressed-terete." He writes also "Fences, Oregon, *Hall.* British Columbia, *Macoun.* Most naturally associable with the genus which shall include *C. aculeata;* but agreeing in the spermogones and their contents with *C. tristis*."

In 1888, Nylander received from Dr. J. W. Eckfeldt* actual material collected on *Pinus contorta* in Oregon and described it as a new species (Enum. Lich. Freti. Behringii, Bull. Soc. Linn. Normandie, Caen 1: (4) 270) of *Alectoria* as *A. cetrariza.* His specific name curiously enough hinted at Tuckerman's original generic distribution, as we now realize that he was renaming the Menzies' plant, though, so far as we know, he did not recognize it as the plant fitting Tuckerman's description which he had quoted. Nylander described it as follows: "Thallus castaneo-

* Topotype No. 44, Eckfeldt herbarium, Acad. Nat. Sci. Phila.

fuscescens subcompressus ramosus erectus (altit. circiter 2 centimetr.); apothecia badio-nigricantia (latit. 2–3 millim.), terminalia; spores 8 nae ellipsoideae minutae, longit. 0.005–8 millim., crassit. 0.0025–35 millim. Iodo gelatina hymenialis fulvescens. Super *Pinus contortam* in Oregon, Tellanock (misit Dr. Eckfeldt). Comparanda cum *A. divergencente,* quae thallum habet teretiusculum, sporas majores. Thallus lamina tenuit rubescens. Spermatia bifusiformia, longit. 0.0045 millim., crassit. 0.0005 millim.; sterigmata breviuscula."

In 1891 (Bull. Torr. Bot. Club **18**: 257. 1891), Dr. Eckfeldt writes under Botanical Notes: "*Alectoria cetrariza* (Nyl.) Eckfeldt. Thallus erect, tufted, caespitose and spreading, slender, softish, at first compressed; lacunose and channeled beneath, the branches becoming terete; terminating in subulate extremities, olivaceous to lead color and darkening, canescent.

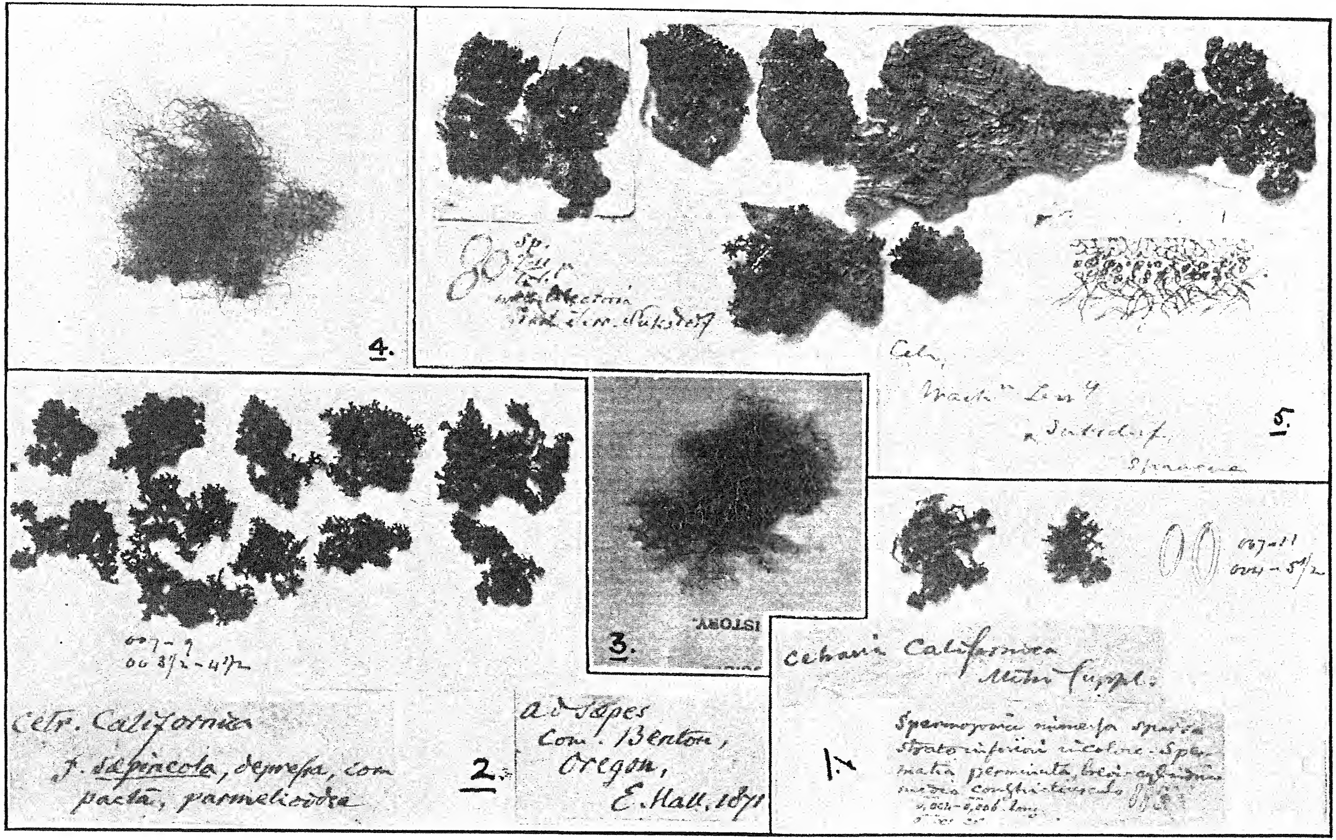
"Apothecia of middling size terminal and subterminal, lead-colored, margin uneven, dentate or disappearing, becoming deflexed with a thin bloom. Spores ovoid-ellipsoid, hyaline continuous, quite constantly $\frac{6\text{–}7}{3\text{–}3\frac{1}{2}}$ mic.

"This lichen was first discovered by Mr. Thomas Howell, in October [30], 1882, on the branches of small shrubs, bordering the sea, at Tillamook, Oregon. From its resemblance and relationship to the well-known *Cetraria californica,* Tuck., no doubt this interesting plant has been collected before, and distributed under an erroneous name. It is evident that this lichen is peculiar only to the northwestern coast."

During the years covered from 1894 to 1903, three sets of exsiccati were issued including specimens of *Cetraria californica* Tuck., *i. e.,* Hasse, No. 192, San Gabriel mts., Cal., Aug., 1896; Cummings, Lich. Bor. Amer. No. 142; Decades No. Amer. Lich. No. 212, Wawona, Cal., May 16, 1896, 3,950 ft.; Zahlbruckner, Kryptogamae Exsiccati, San Jacinto mts., Cal.*

In 1910, Mr. Merrill (Bryologist, l. c.) reviews the history of the plant somewhat vaguely, and makes these important statements: (1) that he had noticed a "discrepancy between the original description" . . . "and the published examples"; (2) that

* See also Herre: Proc. Wash. Acad. of Sciences **7**: 337. 1906 and **12**: 206. 1910.



SPECIES OF ALECTORIA AND CETRARIA

"compressed-terete is scarcely applicable to any condition shown" in his specimens of the above exsiccati; (3) that the above exsiccati specimens are represented in the "Herb. Tuckerman" as "var. *sepincola*"; (4) that the "terete-compressed form" sent him by Mr. A. S. Foster "is really *C. californica* of Herb. Tuckerman," fide Farlow; (5) that in Tuckerman's species the apothecia are "typically *lateral* and affixed in much the same manner of *Ramalina* (*Alectoria*) *gracilis* Nyl. and appendiculate when only one occurs on a stem," etc.; (6) that Nylander's *Alectoria cetrariza* of Eckfeldt is the same plant; (7) that accepting Nylander's view of the generic affinity he proposes the new combination *Alectoria californica* (Tuck.) Merrill; (8) that *Cetraria californica* var. *sepincola* of the Tuckerman herbarium is not "related with *Alectoria californica*" (Tuck.) Merrill; (9) that in the latter plant the thallus is "cylindrical, radial in structure, the apothecia lateral with a commonly entire and smooth margin"; and (10) that *Cetraria californica* Tuck. as represented in the published exsiccati is still undescribed.

We now have, I believe, all the published facts for our consideration. There seems no doubt that Tuckerman fully considered the affinities of the plant he described, and that now reposes in his herbarium. For twenty-three years he found nothing to cause him to change his original distribution. He nevertheless noticed an affinity with the bilocular-spored *Ramalinas* as well as the *Cetrarias*.

Nylander, until he received Dr. Eckfeldt's plant, agreed doubtfully with Tuckerman, and in naming the former's plant showed that he realized a *Cetrarian* affinity by the choice of a specific name.

Dr. Eckfeldt simply proclaimed the work of Nylander, enclosing without reason Nylander's own name in parenthesis.

As it seems probable that the exsiccati distributions were of an unnamed species or variety erroneously determined, we may drop them for the present from our consideration (see *pl. 41*).

Mr. Merrill calls attention to a similarity with *Ramalina gracilis* Nyl., and refers also to a similarity with *Alectoria oregana* Nyl. ex Tuck.

Now, to return to Tuckerman's interpretation of the plant's

structure. The two important considerations lie in the exact cross-sectional structure, not alone form, of the thalline branches, and the position and form of the apothecia. His first (1859) description gives us no account of the former, but calls the latter terminal, appendiculate, margins toothed fimbriate. In 1872 he adds nothing except an account of the spermogones and spermatia. In 1882 he calls the branches "compressed terete"; the apothecia "subterminal . . . appendiculate," the margins disappearing.

Nylander's first (1887) description of the actual plant was of the Eckfeldt specimen whose branches he termed subcompressed; the apothecia he called terminal.

Dr. Eckfeldt himself in 1891 calls the branches "at first compressed . . . becoming terete"; the apothecia "terminal and subterminal," "margins uneven, dentate or disappearing."

Stizenberger in 1892 quotes in litt. from Nylander "Thallus lamina tenui submicroscopio iodio rubens," l. c. 126.

Dr. Herre's descriptions seem composite in the present light (Proc. Wash. Acad Sci. l. c.).

Lastly, Mr. Merrill first states that "compressed-terete" is scarcely applicable, and later inconsistently terms his Foster material "terete-compressed"; in summing up, he later calls the branches "cylindrical, radial in structure." The apothecia he first calls "typically *lateral*" and "appendiculate when only one occurs on a stem, or the uppermost when more than one is found," later he finds them simply "lateral with a commonly entire and smooth margin."

I believe that any one examining material of this plant or No. 82 of Mr. Merrill's "Lichenes Exsiccati" will find the following characteristics true. They will agree with Tuckerman and Nylander that the branches are "compressed-terete," though sulcate (="subcanaliculato," "subfistulous," Tuck.); the apothecia, terminal and subterminal, appendiculate, disk convex, becoming recurved, emarginate, periphery entire, toothed or at length lacerate,—these latter varying conditions due directly to extent of growth. The medulla is densely stupose.

In the National herbarium are the plants here figured in plate 41, which are confirmative of Dr. Farlow's findings in the Tucker-

man herbarium, though a more reduced form is also discovered, *i. e., stygiodes,* not mentioned in Mr. Merrill's paper. I have also examined the Eckfeldt topotype in the Academy of Natural Sciences at Philadelphia, and with it the specimen sent Dr. Eckfeldt by Mr. Merrill for comparison.

If we are to consider this plant an *Alectoria,* as the genus has been commonly understood, we must find the branches structurally cylindrical (=terete), compressed at the axils or along the larger branches; the apothecia lateral, rarely appendiculate (when borne on the short undeveloped branches of *oregana*), generally innate-marginate, margins entire, at length suppressed or fimbriate (*oregana*); the medulla stupose, arachnoid or wanting; the spermogones and spermatia are hardly diagnostic enough for serious consideration among the genera of Usneaceae and *Cetraria.*

I cannot admit of the above diagnostic characters for the plant under consideration though for the most part they are applicable in a loose way. The branches are not truly* cylindrical, the apothecia occasionally appendiculate, the medulla is distinctly dense. If the idea of radial structure is made to include such plants as the one we are considering, we must allow ourselves besides, almost unlimited latitude as to the position of apothecia, even if we waive the margination as in any way diagnostic. The margins within a genus are of course admittedly variable,—the genus *Evernia* has its pseudo-ciliate member in *vulpina; Alectoria* in *oregana,* and the ciliate species of *Usnea* an almost eciliate member in *trichodea.*

Mr. Merrill has remarked on the similarity between *californica* and the thicker, shorter, undeveloped branches of *oregana,* and in a comparison of the short, caespitose branches of the latter plant with *californica* it is admitted a similarity will be noticed. It would seem therefore that the filamentous portions of *oregana* bridge the transitional gap between the pendulous species, and a fertile caespitose condition seen in part in *Alectoria oregana.* As already has been said, and what is also true of the *Usneas,* the caespitose plants are more commonly fertile, and this is true of

* Due to frequency of fistulas, the circular distribution of gonidia is rarely complete.

the caespitose branches of *oregana,* for its filiform branches are generally sterile. No *Alectoria* except *oregana* has been known with other than an innate marginate condition of the apothecia, —in *oregana* it is fimbrio-ciliate.

Now that we have finished the structural considerations, let us turn to the actual material at hand and its distribution. An examination shows clearly that it varies enormously, passing insensibly from reduced degenerate examples (*i. e., stygiodes*), through specimens with broad or narrow lacinia, and finally to those in the subterete condition which are typical of Tuckerman's true *californica.* Tuckerman himself clearly realized the intergradation, for he gave the broad laciniate, rarely canescent examples the name *sepincola.* The littoral and low country examples from central California northward to Washington always approach or are referable to the canescent subterete species, while the specimens from the mountains of California (4000 ft.) to Mt. Benson, Vancouver (3,300 ft.) are referable to the variety *sepincola,* the name first given by Tuckerman to such specimens, for which I propose *Tuckermanii,** as *sepincola* (*Cetraria saepincola* (Ehrh.) Ach. is already in use in the genus, which would cause confusion if this variety were ever raised to a species. As all Tuckerman's material came from a coast (an intermediate) station in southern California the type of the subterete species is not as typical as those specimens from further north, nor are the examples of the compressed variety as robust as those from higher altitudes. For this reason I have not used the Menzies material for the type specimen. *Cetraria californica Tuckermanii* should be used for the plants of the published exsiccati, excluding Mr. Merrill's distribution under *Alectoria californica* (Tuck.) Merrill. His distribution represents typical *Cetraria californica* Tuck.

Cetraria californica Merrill, proposed by Mr. Merrill, would have been a homonym if Mr. Merrill's inference had been cor-

* Type No. 2013 author's herb. No. 142 Lich. Bor. Amer. Wawona, Cal., 3950 ft. alt., May 16, 1896, leg. C. E. Cummings. Thallus caespitosus, laciniis fuscis supra, pallidioribus infra, compressis, angustis vel latis, lacunosis, quorum apices digitati, subdichotomi. Apothecia terminalia vel subterminalia, margine crenulato-dentato, disco nigro-fusco. Sporae 3–5 × 6–10μ. Habitat in variis arboribus.

rect. His inference and Nylander's was based no doubt on insufficient material, which in this case easily leads one astray.

SPECIMENS EXAMINED

OREGON: Benton Co., *E. Hall,* 1871 (NH); Tillamook, *T. Howell,* Oct. 30, 1882 (ANS); Dalles, *J. W. Eckfeldt,* 1880 (74 CGS). WASHINGTON: Westport, no. 82 Lich. Exsic. *Merrill, A. S. Foster,* Jan. 25, 1908 (6304 F). BRITISH COLUMBIA: Mt. Benson, 3,300 ft., Vancouver, *Macoun,* July 10, 1892 (CGS); Kootanay Lake, 5,000 ft., *Macoun,* July 9, 1890 (CGS). CALIFORNIA: San Gabriel mts., *H. E. Hasse,* Aug., 1896 (Hasse distribution); Wawona, *C. E. Cummings,* May 16, 1896 (No. 212 Decade No. Amer. Lich. and No. 142 Lich. Bor. Amer.); San Jacinto mts. (Krypt. Exsic. Zahl.); Stanford, 400 ft., *A. C. Herre,* Oct. 1, 1903 (ACH); Mt. View Landing, *A. C. Herre,* Sept. 30, 1903 (ACH); Alpine creek cañon, 2,000 ft., *A. C. Herre,* Apr. 5, 1905 (ACH); Waddell creek, 1,400 ft., *A. C. Herre,* June 29, 1906 (ACH).

ALECTORIA DIVERGENS (Ach.) Nyl. Synop. Lich. 278. 1858–60

Cornicularia divergens Ach. l. c.

TYPE: not indicated, but the specimen on which the species was based is in the Acharian herbarium, Universitetets Botaniska Institution, Helsingfors, fide Prof. Dr. F. Elfving.

TYPE LOCALITY: "alpibus Lapponicis. Wahlenberg."

ORIGINAL DESCRIPTION: "thallo cartilagineo effuso subcaespitoso glabro fusco-castaneo, ramis compressiusculis subangulosis scabriusculis elongatis laxis divergentibus flexuosis dichotomis attenuatis, apice longe furcellatis curvatis. (Apothecia ignota.)" Meth. Lich. 2: 303. 1803.

FIGURE: Acharius, Meth. Lich. l. c. *pl. 6. f. 1.*

DIAGNOSIS: *Thallus chestnut*-brown, caespitose, filamentous, stout, rigid, *apices furcate.*

DESCRIPTION: *Thallus* caespitose or procumbent, filamentous, stout, rigid, chestnut-brown, branches subterete; *cortex* glabrous, or generally nitidous, often rimulose, exposing white medulla; *primary branches* dichotomous, subdivaricate (max. length 14 cm.); *secondary branches* dichotomous, divaricate; *fibrils* flexuous, furcate. *Apothecia* lateral medium sized (max. diam. 9

mm.), convex, crenulate—marginate, disk chestnut. *Spores* 8–10 × 4.5–5.5μ.

SUBSTRATA: on earth.

GEOGRAPHICAL DISTRIBUTION: Common throughout the Boreal zone. It has been reported from Newfoundland (*Eckfeldt and others*) to Greenland (*Vahl*) on the Atlantic coast, and from Oregon (*Roell*) to Alaska (*Cummings* and *others*) on the Pacific coast. In addition to these localities I have seen specimens from Melville island, Keewatin and Ungava and it has been recorded from Hudson bay (*Bell, Macoun*), Great Bear lake (*Leighton*), and Arctic America (*Richardson*).

OBSERVATIONS: There is little doubt that this species holds a very close relation with the Cetrarias. It is often misdetermined for *Cetraria aculeata* (Screb.) Fr., and in its most luxuriant state resembles not only in color but in structure the true *Cetrarias*. The spore characters have also been described differently by authoritative authors, those here given are compiled from Nylander, Tuckerman, and Crombie who all no doubt gleaned their information from the same source, *i. e.,* specimens from the islands of northeastern Asia.* Nylander at first called the asci "bi-tri-sporae,"† but later Nylander, Crombie and Dr. Zahlbruckner include it under the Section *Bryopogon* to which they attribute 8 spores in an ascus.‡ The size and form of the apothecia is more typical of *Cetraria* than *Alectoria*. There seems little question that this species "Affinitatem magnam praebe[n]t cum *Cetrariis*."

SPECIMENS EXAMINED

NORTH AMERICA: *Drummond* (S). NEWFOUNDLAND: Long Island, *A. C. Waghorne,* Sept. 9, 1893 (NH); *W. Palmer,* Aug., 1887 (NH). LABRADOR: Pack's Harbor, *J. W. Eckfeldt,* 1892–96 (NY, NH); L'ance au Loup, *J. W. Eckfeldt,* 1892–96 (NH, NY); Blanc Sablon, *J. W. Eckfeldt,* 1892–96 (NH); Red Bay, *A. C. Waghorne,* June 8, 1899 (NH); Long Island, *A. C. Wag-*

* Arnold: "mit Apothecien auf Neufundland gesammalt." Lich. Fragm. Oesterr. bot. Ztschr. 46: 11. 1896.

† Synop. 279. 1858–60, also Notis. ur Sällsk. Fauna et Fl. Fenn. 8: 112. 1882.

‡ Nyl., Bull. Soc. Linn. Norm. Coen. 1: (4). 268. 1888: "sporae 8 nae."

horne (CEC); Clearwater Lake, *A. P. Low,* July 12, 1896 (CGS). GREENLAND: Rukstanseek, *Vahl* (NY); Holstensbory, *Th. Holm,* Aug., 1886 (ANS); Christianshaab (NH); ?, *G. Edeling,* 1896 (1,278 CM). UNGAVA: Diggs Island, *R. Bell,* Sept. 15, 1884 (CGS). BRITISH COLUMBIA: Vancouver Island, *J. Macoun,* May 17, 1893 (NY); Parson's Mt., *J. Macoun,* May 17, 1893 (CEC, 3,174 F). ALASKA: Pt. Barrow (NH); St. Michael's, *W. A. Setchell,* July 19, 1899 (NH); Seward Pen., *A. J. Collier,* 1900 (NH); Cape Nome, *W. A. Setchell,* July, 1899 (CEC); St. Michael's, *S. M. Turner,* Sept., 1875 (CEC); Hall Island, *W. Trelease,* July 14, 1899 (CEC); Kadiak Island, *W. Trelease,* July 21, 1899 (CEC); Bering St., *C. Wright,* 1853 (NH). YUKON: near Dawson, *R. S. Williams,* Apr. 2, 1899 (1860 H). FRANKLIN: Melville Island, *E. Parry* (S). KEEWATIN: *J. W. Tyrrell,* July 28, 1893 (CGS).

ALECTORIA CHALYBEIFORMIS (L.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 408. 1821

Lichen chalybeiformis L. l. c.

TYPE: Species is based on *Usnea rigida horsum,* etc., of Dillenius; the Dillenian specimen, "Infertile," is in the Dillenian herbarium, Botanic Gardens, Oxford, England, and is *Alectoria jubata,* var. *chalybeiformis* (L.) fide Crombie. In the Linnaean herbarium, "*Lichen chalybeiformis* (886) = *Alectoria chalybeiformis* Wainio, Adj. I, p. 115, status thallo paululum vel sat implexo fusco—vel olivaceo-nigricante (*Alect. prolixa* var. *chalybeiformis* Auct.) fide *Wainio.*

TYPE LOCALITY: "Europa."

ORIGINAL DESCRIPTION: "filamentosus subramosus decumbens implicato-flexuosus," L. Sp. Pl. 2: 1155. 1753.

FIGURES: [Dill. Hist. Musc. *pl. 13. f. 10.* 1741.] Oeder, Fl. Dan. 2: *pl. 262.* 1766.

DIAGNOSIS: *Thallus* caespitose, brown, branches flexuous, *wiry* terete, often spinulose, and generally *abundantly ruptured* with *white soralia.*

DESCRIPTION: *Thallus* caespitose, precumbent or rarely subpendulous, filamentous, wiry, terete to subterete, often spinulose, dark to light brown; *cortex* glabrous or nitidous, occasion-

ally rimulose, often abundantly ruptured with white soralia; *primary branches* flexuous, dichotomous, divaricate, axils occasionally compressed (max. length 12 cm.); *secondary branches* dichotomous; *fibrils* short. *Apothecia* unobserved.

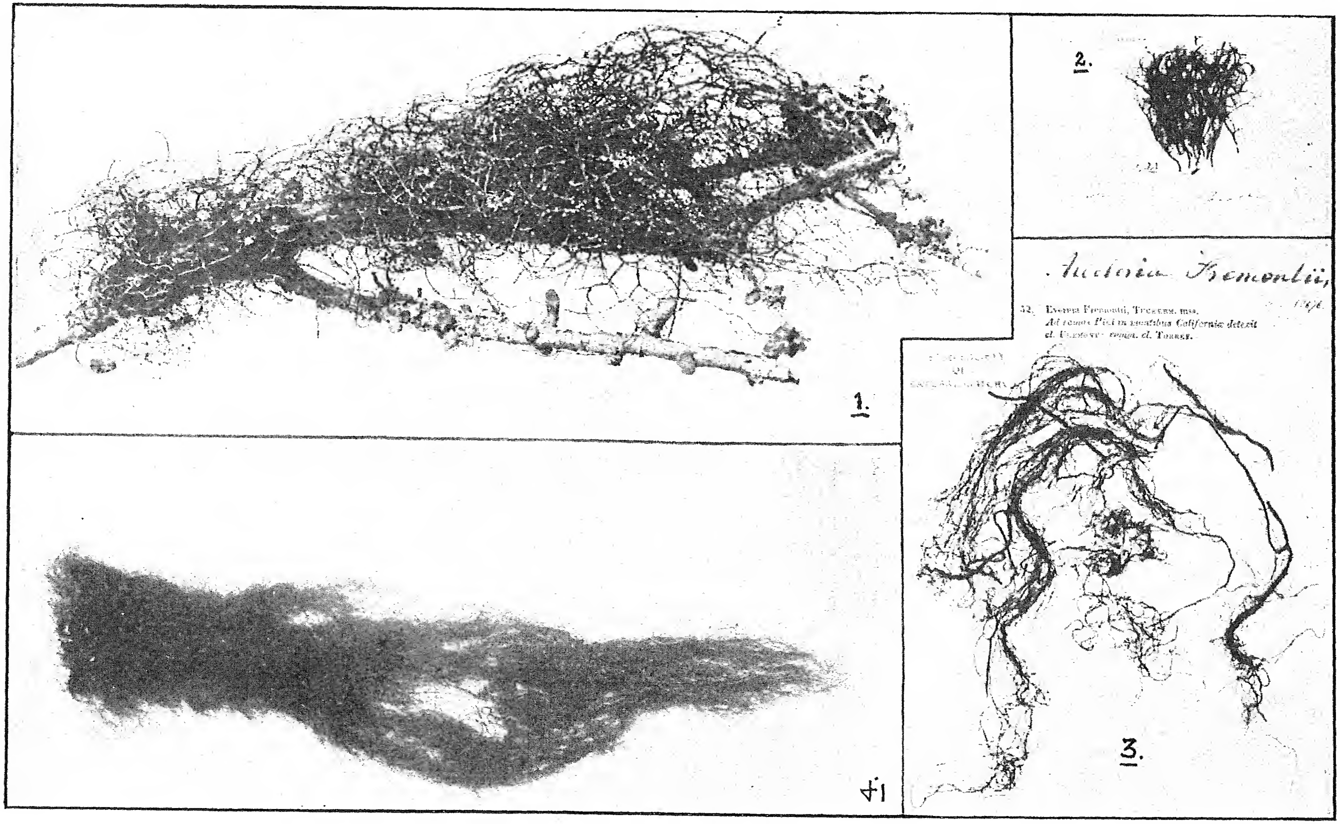
CONTINGENT PHASES: (*a*) yellowish-brown. (*b*) proximal portions black.

SUBSTRATA: On living and dead trees, on old fence rails, and occasionally on moss and humus covered rocks.

GEOGRAPHICAL DISTRIBUTION: Common throughout the Transition and Boreal zones, occurring sparingly in the upper Austral. It is recorded from Oregon (*Roell*), British Columbia (*Macoun*) to Alaska (*Cummings*) in the west, and occurs from Virginia and Maryland to Labrador (*Eckfeldt*) in the east. It occurs in the middle states from Iowa, Illinois (*Fink*), and Minnesota (*Fink*) northward to Great Bear lake (*Richardson, Leighton*) and Greenland (*Vahl, Macoun*). It is also found commonly in the Boreal swamps of the upper Austral zone.

OBSERVATIONS: This plant, which, according to Crombie has never been found bearing apothecia,* is distinguished by its wiry, rigid thallus. Its branches in most specimens are spinulose and largely ruptured with white soralia. Though I have examined a great many specimens I have never seen a fertile plant, yet Tuckerman records it as follows: "White Mountain, fertile, *Lesquereux;* as also on branches of firs in cold swamps, where equally fertile"; Dr. Farlow informs me, however, that at present no fertile specimen is in the Tuckerman herbarium collected by Lesquereux. It has been argued (*Fink*) that in the absence of apothecia it should be kept as a variety of *jubata,* and if it had not already been raised be Gray, Nylander, Wainio, and Norrlin to specific rank I would hesitate to do so. The generally caespitose and wiry thallus seem sufficient grounds for recognizing it as a species, for it certainly shows little intergradation with the pliant and pendulous *jubata* or the more lax and pendulous *implexa.* It does not seem likely that *jubata* is another condition of growth of this same plant, but rather more probable that it is not as yet known in a fertile state. To grant this, however, we must believe such an experienced and careful a worker as Tuckerman at fault.

* Lightfoot, Fl. Scot. 892. 1777, records it fruited.



SPECIES OF ALECTORIA

In regard to its distribution, it is quite likely that some of the northernmost records above cited may be erroneous, and refer in reality to the species that follows, which it resembles distinctly more than *jubata* or *implexa*. In point of fact the one specimen (NY) I have seen of *A. bicolor Berengeriana* Mass., suggests a close *chalybeiformis* relationship. As I have studied these plants it has frequently crossed my mind that *bicolor* might someday prove to be the fertile state of *chalybeiformis*. The latter is not uncommonly found with blackened basal portions, (the two, in fact, are plainly much alike in color) and its more boreal distribution is compatible with this idea. I have also wondered whether this theory did not perhaps explain the Tuckerman statement. So far as the chemical tests of Nylander and Crombie have weight, it is also suggestive that *chalybeiformis* and *bicolor* were given the same reaction, distinguishing the two from the rest of the *jubata* group. Just as *hirta* is the sterile, but sorediate condition of *Usnea florida* (L.) Web., may not *chalybeiformis* be the soraliate (more rigid) condition of *bicolor?* With more material of the latter plant for study, I hope to be able to ultimately reach a decision of this now circumstantial, yet I feel perhaps not improbable view.

NOTE: *Alectoria jubata lanestris* Ach. Lich. Univ. 593. 1810. Reported from Oregon (*Roell*), Flora, **72**: 262. 1889, and in Newfoundland by Stizenberger, l. c. 129. I have not seen this form and cannot judge of its importance, it was described as follows "lorulis ramisque prostratis tenerrimis mollissimis implicatis atris opacis. Habitat in ramis arborum Helvetiae."

Alectoria nidulifera Nyl. ex Norrl. Flora **33**: 8. 1875. Reported from Miquelon island by Arnold (Flora **71**: 82. 1888). According to Tuckerman, this species is not separable from *Alectoria chalybeiformis* (see however Bryologist, **14**: 37. 1911). The original description is as follows: "Thallus olivaceo-spadiceus erectus minusculus (1–2-pollicaris, crassitie basi circiter 0.5 millim.), patenti-ramosus, sat dense arbusculiformis, ramis subflexuosis, passim sorediosus, sorediis albidis non prominulis, saepius propagula erectula emittentibus indeque spinulosis. Supra truncos pini in Findlandia media frequens (Norrlin)."

Alectoria (Bryopogon) jubata y. nitidula Th. Fr. Lich. Arctoi.

26. 1860 and Lich. Scand. 25. 1871. This variety has lately been included by Mr. Merrill as a North American plant (Bryol. l. c.). I have seen one specimen that seems perhaps referable to it, but since I have found no other material I hesitate to definitely accept this boreal variety. It was defined as follows: "thallus *erectus, brevis,* subcaespitosus, *rigidus,* fusco-niger, nitidus, *sorediis destitutus,* apicibus curvato-deflexis *concoloribus.*" "Norlandiae . . . Finmarkiae . . . Dovrensium."

Material from St. Pauls island and Baffin land I have referred to *jubata,* though in every respect they answer to this description, except for their *prostrate* and slightly soraliate condition,—they may however be better placed under *chalybeiformis.*

SPECIMENS EXAMINED

NEWFOUNDLAND: Sampson Is., *A. C. Waghorne,* Sept. 11, 1893 ?(CEC). ONTARIO: Nipigon river, *Macoun,* July 2, 1884 (CGS); Cache Lake, July 11, 1900 (CGS); Belleville, Aug. 17, 1868 (CGS). NOVA SCOTIA: Halifax, *J. W. Eckfeldt,* Aug. 4, 1890 (ANS). NEW BRUNSWICK: (S); Cape Breton island, *Macoun,* July 9, 1898 (CGS). MAINE: South West Harbor, *S. Lorvey,* Aug. 19, 1909 (1706 H); North Lubec, *C. E. Cummings,* etc., July, 1893, No. 16. Lich. Bor. Amer. (390 H); Brunswick, *M. Copeland,* July, 1909 (1157 H); Gerrish Is., *C. P. Heffenger,* 1910 (1971 H); Megunticook Lake, *A. L. Crockett,* Jan. 28, 1903 (8 SM); Manchester, *F. L. Scribner,* 1876 (ANS); Lubec, *P. L. Riker,* July 23, 1897 (NH); Cumberland, *Blake,* Dec., 1855 (NH et 980 F); Manchester, *F. LeR. Sargent* (NH); Portland, *A. H. Norton* (P); Fryeberg, *L. W. Riddle,* Aug., 1907 (1 R); Portage, *L. W. Riddle,* Aug., 1907 (112 R); Old Town, *L. W. Riddle,* Aug., 1907 (113 R); Orono, *M. L. Fernald,* July 11, 1892 (CEC); Cumberland, *J. Blake,* Dec. 5, 1855 (UM); Belmont, *J. Blake,* Sept. 17, 1878 (UM); Orono, *F. H. Harvey,* Oct., 1893 (UM); Bangor, *E. D. Merrill,* May 23, 1896 (UM). NEW HAMPSHIRE: Fitzwilliam, *F. J. Bassett,* Aug., 1909 (1679 H); Mt. Monadnock, 2,000 ft., *R. H. Howe, Jr.,* Apr. 5, 1906 (391 H); Hanover, *F. G. Blake,* Oct. 31, 1905 (388 H); Nashua, *P. Mott,* Sept. 29, 1908 (40 H); Rye, *C. P. Heffenger,* Apr., 1910 (1899 H); Belknap Co., *L. A. Carter,* Aug. 6, 1901 (6

SM); Plymouth, *C. E. Cummings,* Mar., 1891 (CEC). Vermont: Norwich, *F. G. Blake,* Dec. 6, 1905 (386 H). Massachusetts: Sudbury, *C. M. Carr,* Oct. 17, 1905 (387 H); Townsend, *R. H. Howe, Jr.,* Dec. 28, 1905 (385 H); Worcester, *E. L. Horr,* Jan., 1906 (381 H); Mt. Watatic, 1,500 ft., *R. H. Howe, Jr.,* Dec. 28, 1905 (383 H); Bedford, *R. H. Howe, Jr.,* Jan. 26, 1906 (382 H); Carlise, *R. H. Howe, Jr.,* Oct. 22, 1905 (384 H); Mt. Toby, *T. P. Adams* (S); Amherst, *A. Clark,* 1875 (NH); New Bedford, *H. Willey,* 1862–98 (NH); Wellesley, *C. E. Cummings,* Dec. 21, 1883 (W); New Bedford, *H. Willey* (B); Hingham, Russell (B). Rhode Island: *T. J. Bennett* (R); *Olney?,* Mar. 29, 1846 (B); *Olney?,* Dec. 11, 1847 (B). Connecticut: Cromwell, *H. A. Green,* July 10, 1887 (979 F); Ellsworth, *H. A. Green,* Aug. 9, 1884 (1278 CM). New York: Chilson Lake, *C. W. Harris,* Aug. 1, 1900 (3 SM, NH, et NY); Penn Yan, *P. V. LeRoy* (NY); *L. W. Riddle,* Jan., 1908 (406 R); *Sortwell* (B). New Jersey: Closter (CGS). Pennsylvania: Bucks Co., May 30, 1883 (ANS). Maryland: Hamilton, *C. C. Plitt,* Dec. 14, 1909 (CCP). District of Columbia: *E. Lehnest,* 1883 (NH). Virginia: Hot Springs, 1851 (S); Norton, Cumberland Mts., *A. B. Seymour,* July 27, 1891 (No. 53, Dec. No. Amer. Lich. (BSNH); White Top Mt., 5678 ft., *H. D. Leming,* July 26, 1892 (CEC). Iowa: Fayette, *B. Fink* (1896 H); Clayton Co., *B. Fink,* 1895 (3187 F). Minnesota: Beaver Bay, *B. Fink,* July 15, 1807 (NH); Snow Bank Lake, *B. Fink,* July 20, 1897 (3185 F); *B. Fink,* 1896 (3184 F). Oregon: *W. W. Calkins* (W). Assiniboia: Farewell creek, *Macoun,* June 27, 1895 (CGS). Alberta: Jumping Pound creek, *J. Macoun,* June 14, 1897 (CGS). British Columbia: Mt. Benson, Vancouver island, *Macoun,* June 27, 1893 (CGS). Alaska: Unalaska, *J. Macoun,* Aug. 21, 1891 (ANS, CGS).

Alectoria bicolor (Ehrh.) Nyl. Prod. Lich. Gall. et Alg., Act. Soc. Linn. 1: 291. 1856, separate 45

Lichen bicolor Ehrh. l. c. 82.

Type: Plantas cryptogamas Linnaei, Decade 4: No. 40. 1784.

Type locality: "Rennekeberg und Rehberg," Germany.

Cricinal description: "Er ist ein Lichen filamentosus, ramo-

sissimus, erectiusculus, teres, inarticulatus, glaber, nitidus, inanis, infra nigricans, supra sordide albidus, intus griseus; ramis patentissimis: extremitatibus simplicibus, subulatus," Ehrh., Beitrage zur Naturkunde, **3**: 82–83. 1788.

FIGURES: Acharius, Nya Handl. Kongl. Vetenskaps Acad., Stockholm, **22**: *pl. 4. f. 6a–b.* 1801.

Sowerby, Eng. Bot. **26**: *pl. 1853.* 1808.

DIAGNOSIS: *Thallus caespitose,* proximally *black,* apices *pale,* branches rigid, nitidous.

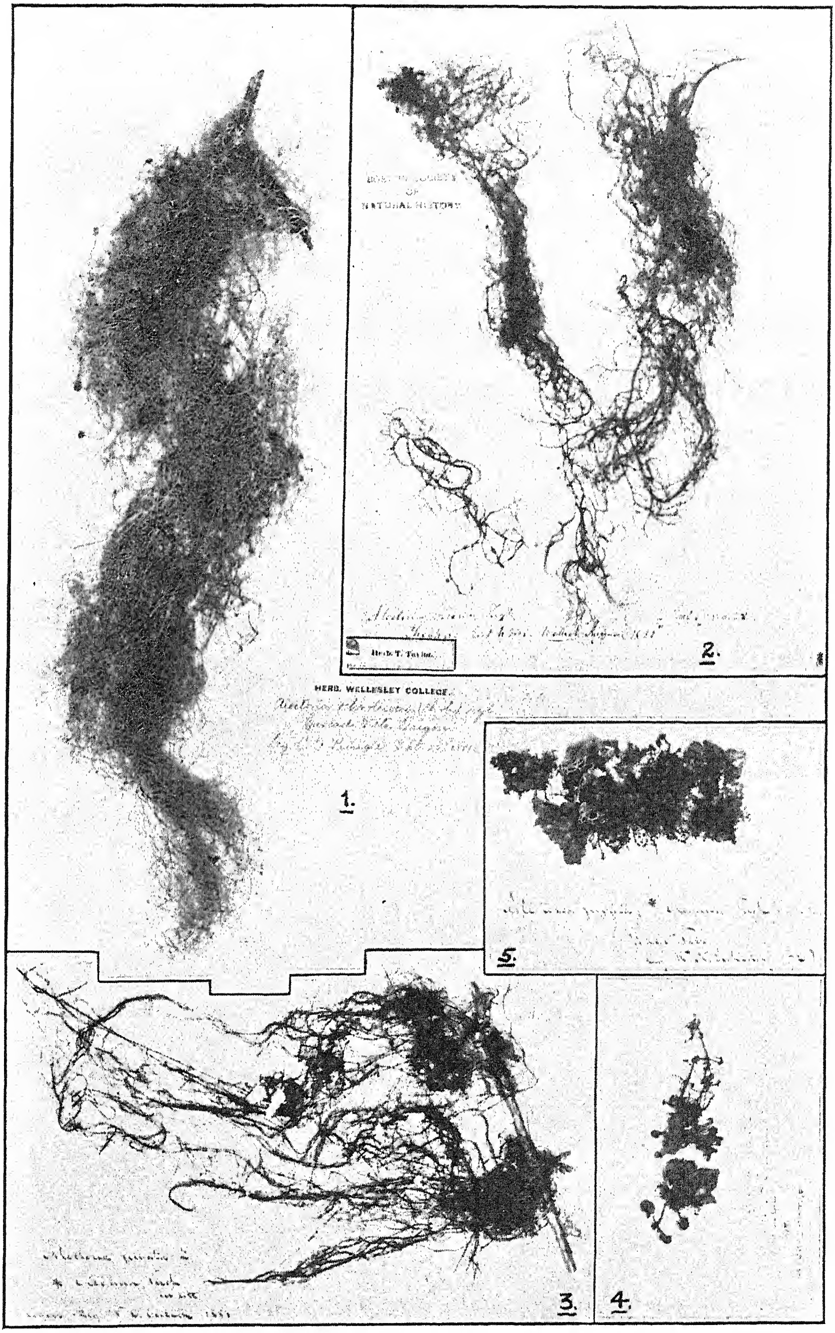
DESCRIPTION: *Thallus* caespitose, erect or procumbent, filamentous, rigid, branches terete, proximal portions black, apices paler to yellowish; *cortex* nitidous, occasionally slightly ruptured with soralia; *primary branches* dichotomous, divaricate, flexuous, slender (max. length 11 cm.); *secondary branches* dichotomous, divaricate; *fibrils* short. *Apothecia* lateral, rare, small (max. diam. 2–3 mm.), convex, innate-marginate, disk concolorous, or pale brown. *Spores* $5–9 \times 4–7\mu$.

SUBSTRATA: On earth, and with mosses over rocks, also on coniferous trees.

GEOGRAPHICAL DISTRIBUTION: Common in the Boreal zone. It has been reported from the following eastern stations: Greenland (*Vahl*); Labrador (*Arnold and others*); Newfoundland (*Eckfeldt, Arnold*); Maine (*Eckfeldt*); New Hampshire (*Tuckerman*). Dr. Eckfeldt records it from Sussex Co., N. J., but in view of the plant's boreal range this record seems doubtful. The only western station is Alaska (*Cummings*). I have seen the typical plant from Labrador, New Hampshire, and Maine, on the Atlantic coast, and from British Columbia, Alberta, Yukon, and Alaska on the Pacific.

OBSERVATIONS: This plant is likely to be confused only with *nitidula,* and particularly, as already noted, with *chalybeiformis.* From the former it may be distinguished by its bicolored and more slender thallus, and simple apices; from the latter by its espinulose and esoraliate branches, which are generally largely unicolored.

NOTE: *Alectoria bicolor Berengeriana* Mass. (Anzi, Lich. rariores veneti, etc., Fasc. I, No. 17. 1863) has been reported from Newfoundland by Stizenberger—"Berenger und in Newfoundland (im Herbar Hegelschw. als *A. divergens*)," l. c. 127.



SPECIES OF ALECTORIA

I have seen but one European specimen of this plant (NY) which seems like a highly spinulose condition of *chalybeiformis*. I have been unable to secure the original description of this variety.

SPECIMENS EXAMINED

LABRADOR: Battle Harbor, *A. C. Waghorne*, Aug. 25, 1891 (ANS). NEWFOUNDLAND: ? Harbor, *A. C. Waghorne*, 1890 (ANS). MAINE: Blanchard, *F. G. Blake*, Jan. 1909 (1818 H); Camden, *A. L. Crockett*, May 18, 1901 (4 SM). NEW HAMPSHIRE: White mts., *Tuckerman*, fertile (S); *Tuckerman*, 1840 (NH); Mt. Liberty, *C. E. Cummings*, Aug. 24, 1892 (3183 F); Franconia mts., *C. E. Cummings*, Aug. 19, 1893? (ANS). ALBERTA: Morley, *Macoun*, June 13, 1885 (CGS). BRITISH COLUMBIA: New Westminster, *J. Macoun*, Aug. 28, 1893 (ANS). YUKON: Crater Lake, *R. S. Williams*, May 24, 1898 (1861 H). ALASKA: St. Pauls Is., July 24, 1897 (3181 F); Kakutat Bay, *W. Trelease*, June 22, 1899 (CEC); Baranoff Is., *DeA. Saunders*, June 15, 1899 (CEC).

ALECTORIA OREGANA Nyl. ex Tuck. Herb. Lich. Japoniae, Accedunt obser. Lich. in Labuan, Paris, 104. 1890

TYPE: No. 72, Tuckerman herbarium, Botanic Museum, Harvard University, Cambridge, Mass., fide *Dr. Farlow*.

TYPE LOCALITY: Oregon.

ORIGINAL DESCRIPTION: "Subsimilis *A. prolixae* f. *lanestris* Ach., thallo fusco-nigricante tenui denso; apothecia spadicea (latit. 2–5 millim.), receptaculo ciliato; sporae 8 nae breviter ellipsoidaea, long. 0.005–6, crass. 0.0035–43 millim. I gel. hym. coerulescens, dein fulvescens. Thallus basi pallescens K (CaCl) —. — In Oregon (corticola videtur), species insignis praesertim apotheciis receptaculo usneoideo-ciliato."

DIAGNOSIS: *Thallus* caespitose to pendulose, *red-brown*, apothecial margins *fimbrio-ciliate*.

DESCRIPTION: *Thallus* caespitose to pendulous, rigid-filamentous portions lax, subterete to compressed, brown to reddish-brown; *cortex* glabrous, dull, rarely nitidous, subcanaliculate; *primary branches* rigid, short (2 cm.), stout, subdichotomous, becoming filiform and pendulous; *secondary branches* filiform; pendulous, subdichotomous; *fibrils* capillaceous. *Apothecia* common, small (max. dia. 7 mm.), appendiculate or lateral,

convex, emarginate, periphery fimbrio-ciliate, concolorous to dark brown. *Spores* 5–8 × 3–5 μ.

SUBSTRATA: On trees.

GEOGRAPHICAL DISTRIBUTION: Confined apparently to the Boreal zone of the western coast states from California to British Columbia, east to western Montana. The San Diego record seems very doubtful from the point of view of locality.

OBSERVATIONS: This alpine species, described by Nylander after Tuckerman's death, though restricted in its range, is one of the most unique and easily determined species. It is commonly fertile, and its ciliate apothecia distinguish it at once from all other species of our area.

SPECIMENS EXAMINED

CALIFORNIA: Mt. Shasta, 3,800 ft., *G. M. Pendleton,* Sept. 12, 1909 (1094 SM); Sisson, *M. A. Howe,* July, 1894 (NY); San Diego, *E. Palmer,* 1875? (NH); Tehachapi mts., 3,000 ft., *H. E. Hasse,* 1901 (1844 H). OREGON: Union, *W. C. Cusick,* 1879 et 1881 (S et NH); *Suksdorf* (NH); Union, *W. C. Cusick* (CEC). WASHINGTON: Goldendale, *A. S. Foster,* Dec. 10, 1909 (941 SM); Spokane, *T. A. Bonser,* Apr., 1908 (730 SM); *W. N. Suksdorf,* No. 72. Cotype (S); *W. W. Calkins* (W). MONTANA: Columbia Falls, *R. S. Williams,* Apr. 27, 1893 (NY); Columbia Falls, *R. S. Williams,* Oct. 31, 1894 (ANS); Belt mts., *R. S. Williams,* Sept. 15, 1890 (NH); Columbia Falls, no. 96 Decades No. Amer. Lich., *Cummings, R. S. Williams,* Apr. 27, 1893 (402 H); Columbia falls, No. 18 Lich. Bor. Amer., *R. S. Williams,* Apr. 27, 1893 (3173 F). BRITISH COLUMBIA: Kootanay Lake, 6,000 ft., *Macoun* (CGS).

NOTE: Stizenberger* described in the Proceedings of the California Academy (5: (2), 537–538. 1895) a new caespitose *Alectoria* from Guadalupe Island off the coast of Lower California. The type or topotype is now in the National herbarium with a postal card from Stizenberger to Henry Willey from whom he received the plant dated August 24, 1893. In view of the fact that only scanty, sterile material is available I prefer to give here only Stizenberger's account:

* A List of Lichens collected by Mr. Robert Reuleaux in the Western Parts of N. America.

"It still remains to add here the diagnosis of a new western lichen, kindly sent me by Mr. Henry Willey, New Bedford, Mass.

"*Alectoria pacifica* Stzb. n. sp.

"Thallus fruticulose, prostrate, rigid, terete, smooth, brown and shining, from 1 to 1.5 cm. in length, 1–0.5 mm. in width, very much divaricately branched, the branches flexuous, densely intangled, 0.05 mm. in width, apothecia and spermogonia unknown.

"The anatomical structure perfectly agreeing with *Alectoria;* no traces of an orthogonal-trajectoric direction of hyphae (as it is found in *Cetraria aculeata*). Cortical and medullary layer equal, nearly longitudinally running filamentous elements. No central cavity; medullary layer cottony, very loose, sprinkled with heaps of gonidia (these 0.004–8 mm. in diameter). Thin sections of the thallus bordered with a very thin light-brown line. The cortical layer neither thickened nor interrupted by layer cavities (which are frequent in the older cortical tissue of *Cetraria*). No reactions on application of hydrate of potassa and hypochlorite of lime.

"Found in the Island of Guadalupe (Pacific Ocean), on humous earth, by Dr. [E.] Palmer [in 1875]."

NOTE: *Alectoria divergens abbreviata* Müll. Arg. Lich. Oregonenses, Flora, **72**: 362. 1889. This form was described as follows: "Mt. Hood in Oregon, ad terram et ramulos dejectos: n. 111, forma abbreviata, vix pollicaris, compacta, fertilis, sporis 8^n, 6–9μ longis et 4½–5½μ latis."

ALECTORIA JUBATA (L.) Ach. Lich. Univ. 592. 1810

Lichen jubatus L. l. c.

TYPE: Species based on *Usnea jubata nigricans,* etc., of Dillenius; the Dillenian specimens "sterile . . . quite typical" are in the Dillenian herbarium, Botanic Gardens, Oxford, England, and are *Alectoria jubata* (*prolixa*), Ach. fide *Crombie.* In the Linnaean herbarium the species is represented by composite material, though "No. 73=in 1 folio: *Alectoria chalybeiformis prolixa* (Ach.) ... in alio folio.. .*Alectoria jubatae* Wainio," fide *Wainio.*

TYPE LOCALITY: "Europae."

ORIGINAL DESCRIPTION: "filamentosus pendulus: axillis compressis," L. Sp. Pl. **2**: 1155. 1753.

FIGURES: [Dill. Hist. Musc. *pl. 12. f. 7.* 1841].

DIAGNOSIS: *Thallus* pendulous, brown, primary branches sulciform, subterete, axils compressed. *Apothecia concolorous* or pale brown.

DESCRIPTION: *Thallus* pendulous, filamentous, pliant, subterete, subtortulous, brown; *cortex* glabrous or dull, sulciform, rarely ruptured with white soralia; *primary branches* remotely dichotomous, axils compressed (max. length 40 to 50 cm.); *secondary* branches dichotomous slender, filiform; *fibrils* capillaceous. *Apothecia* rare, small (max. diam. 2 mm.), convex, innate, margin entire, disk dull, concolorous or pale yellowish. *Spores* 5–9 $\times$ 4–7μ.

CONTINGENT PHASES: (*a*) Cinereous or partially cinereous (*Alectoria jubata cana* Ach. l. c. 593).

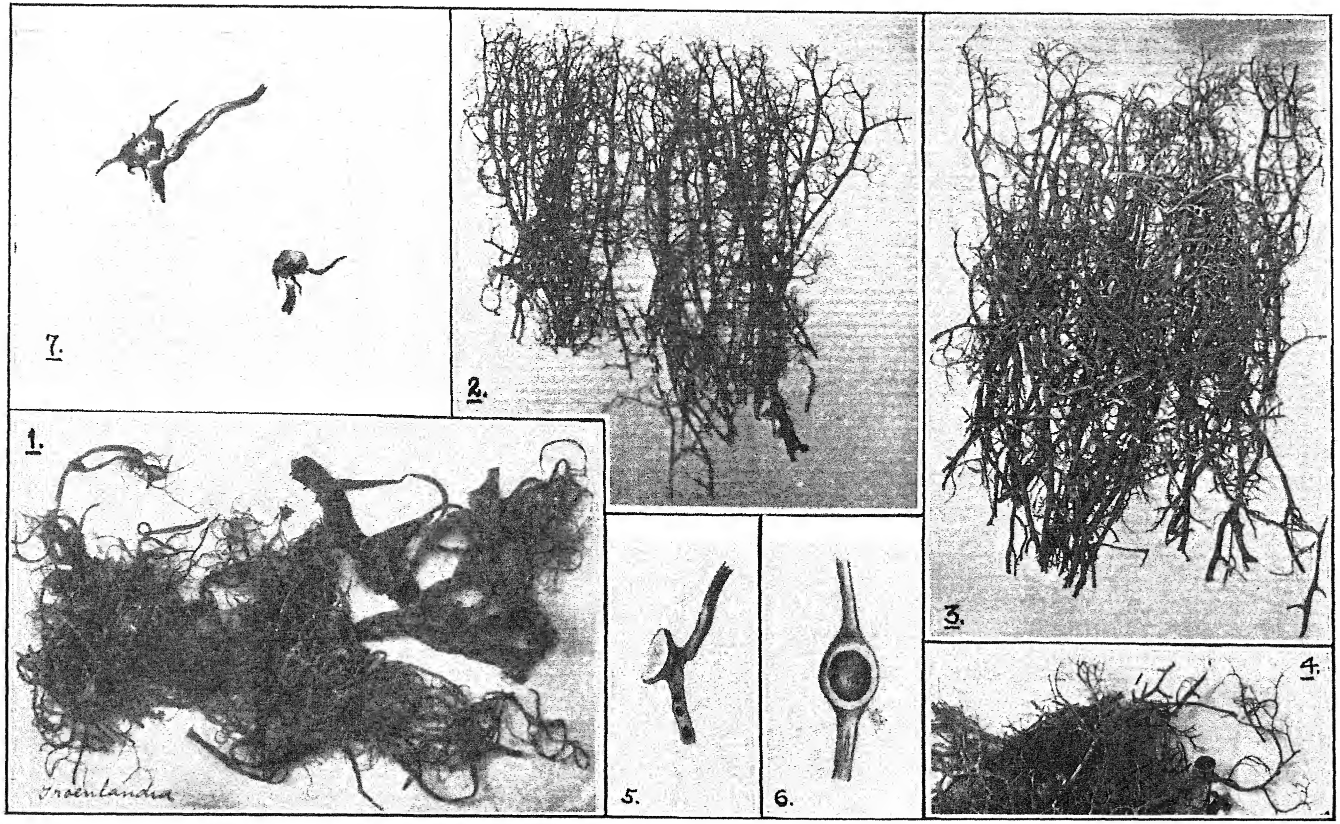
SUBSTRATA: On living and dead coniferous and deciduous trees, more common on the former.

GEOGRAPHICAL DISTRIBUTION: This plant is not typically represented in North America, but is largely replaced in the west by the closely allied species *Fremontii*.

OBSERVATIONS: As was in the case of the genus *Usnea, jubata* like *barbata* has come to have a sectional rather than a specific concept, and the varieties *prolixa* and *implexa* have included *jubata*, or else *jubata* has stood for merely atypical specimens of the varieties. Stizenberger* dropped *jubata* altogether, beginning his nomenclature from Acharius, but as *jubata* seems to be unquestionably a synonym of *prolixa*, and has priority, it must stand. *Prolixa* (sulciform) has never in this country (*Macoun*) been seriously considered as a valid variety, and it is generally known as a variety of *jubata*. *Implexa* has been given correctly by American lichenologists to the slender, eastern specimens whose length does not usually exceed 10 to 15 cm., while *jubata* has been often wrongly reserved by careful workers for the sterile examples of *Fremontii*.

Tuckerman's diagnosis of *jubata* includes the entire range from tufted conditions of the variety *chalybeiformis* to the pendulous *implexa*, and also those pale specimens referable to the variety *subcana*. Below, under (*b*) and (*c*), he gives additional

* See also Hue, Lich. extra-Europ. Nouv. Arch. Mus. d'hist. nat. 1: (4). 86. 1899.



SPECIES OF ALECTORIA

characters to distinguish the varieties. *Jubata* in the Tuckerman sense, like *barbata*, therefore, it will be seen includes collective specific characters.

Crombie has brought into use the chemical tests to separate *implexa* from *jubata*, but though I have faithfully tried them I fail to find the reactions conclusive or helpful. Crombie's results, moreover, do not agree with those given by Nylander. Stizenberger, however, claimed that Nylander's tests "brachte allmälig* Licht in das Chaos," and though not questioning their diagnostic aid, I have sought and found structural differences of value, though intergradation undoubtedly occurs.

The brown, pendulous species of *Alectoria* are plants of wide cosmopolitan distribution. From their high development, like *Usnea*, during an evidently extended evolution by three modes of reproduction (spore, soralial, fragmentary) they have become wonderfully variable, and as with all the filamentous, cylindrical species now rarely develop apothecia. The fragmentary method of reproduction is not only the most common, but hinders the apothecial, which consequently becomes rare. There seems to exist for each lichen species, however, an area where particularly acceptable environment finds a usually sterile species fruiting commonly, *i. e.*, *Usnea angulata* Ach. in the Bolivian Andes. In both hemispheres a maximum length of 30 to 40 cm. is reached, and the plants show a color gradation from almost black-brown to pale gray. A parallelism with *Usnea* in the matter of distributional development is clearly shown; central Europe and the northern Pacific coast supporting the most luxuriant growths,—eastern United States the most reduced.

I have included in this paper a diagnosis and description of true *jubata* that students may recognize the limits of *jubata*, and be able to make comparisons with our allied species. A clear understanding of *jubata* will I think eliminate the future erroneous recording of it from this continent. Personally I have yet to see a typical specimen from North America, its nearest congeneric representative being *Fremontii*, while the variety *implexa* that follows, is the plant common to the larger part of our area.

* Stizenberger uses this word to indicate early discrepancies among authors.

Stizenberger did not report his synonymous *prolixa* from our area, attributing it only to Greenland.

I am listing after this species, plants that seem to me transitional examples, though they for the most part more nearly approach the variety *implexa*. The locations given indicate a somewhat local region of our area, where such specimens are evidently most likely to be found. This area it will be noted, more or less coincides with that of heavy rainfall.*

NOTE: *Alectoria jubata stricta* Ach. (Lich. Univ. 592. 1810). Distributed by Prof. John Macoun from Colquitz river, Victoria, British Columbia. The material is inseparable from the var. *implexa*, and Acharius' variety has not been to my knowledge recognized in recent years. The original description is as follows: No type locality was cited, "lorulis ramulisque pendulis coarctatis rigidiusculis strictis nigris."

SPECIMENS EXAMINED

TENNESSEE: ?, *W. W. Calkins,* July, 1889 (1268 CM). COLORADO: ?, *Vasey* (NH); Boulder Co., *A. Morgan,* Mar., 1898 (CEC). MINNESOTA: Grand Portage, *B. Fink,* May 18, 1897 (NH). IDAHO: Lake Waha, 2,000 ft., *A. A. & E. G. Heller,* July 3, 1896 (NH). UTAH: Uintah mts., 7,500 ft., *L. H. Pammel,* July, 1902 (6568 F). OREGON: Mt. Hood, *T. Howell,* Oct. 30, 1882 (ANS); Castle Crag Springs, *F. A. Walpole,* Aug. 27, 1902 (NH); ?, *W. N. Suksdorf* (NH); ?, *E. Hall,* 1876 (NH); Mt. Hood, 3,000 ft., *F. C. Frye,* Aug. 28, 1907 (4,870 ft., F); Mt. Hood, 3,000 ft., *A. S. Foster* (R). BRITISH COLUMBIA: ?, *J. T. Rothcock,* 1865 (NH); Emerald Lake, 4,300 ft., *A. Patterson,* June 29, 1904 (CM); Big Bend, 6,000 ft., *H. Shaw,* July 24, 1905 (3563 CM); Mt. Benson, Vancouver, *Macoun,* July 10, 1893 (CGS); Spencer's Bridge, *Macoun,* May 28, 1889 (CGS); Revelstone, *Macoun,* May 16, 1890 (CGS), Skeena river, *J. M. Macoun,* Oct. 2, 1891 (CGS). NEW BRUNSWICK: Prince Edward Island, *Macoun,* July 16, 1888 (CGS). NEWFOUNDLAND: New Harbor, *A. C. Waghorne* (ANS); (S). FRANK-

* Arnold: records the synonymous var. *prolixa* from Labrador and Newfoundland. Lich. Fragm. l. c. 1896, 1899. Müller Arg. from Washington (Flora: 72: 262. 1889).

LIN: Baffin Land, *R. Bell*, July, 1897 (CGS). ALASKA: St. Paul Island, *J. M. Macoun*, Aug. 18, 1892 (CGS).

ALECTORIA JUBATA IMPLEXA (Hoffm.) Ach. Lich. Univ. 593. 1810

Usnea implexa Hoffm. l. c. 134. 1795.
Setaria trichodes Mich. Flora Bor. Amer. **2**: 331. 1803.
Alectoria jubata f. *minuscula* Merrill, Bryologist, **14**: 36. 1911.

TYPE: "*Usnea implexa* (Hb. viv. p. 453: *U. implexa* Hoffm. Germ.") = *Alectoriae jubatae* (Wainio, Adj. 8, p. 116) lusus, thallo tenuiore, quam in *setacea* Ach., cui habitu satis est similis, basin versus cano, apice obscurato." Fide *Wainio* in Meddel. Soc. Fauna et Flora fennica, **14**: 12. 1886.

TYPE LOCALITY: "Deutschland."

ORIGINAL DESCRIPTION: "*U. implexa*, filamentosa decumbens implexa, filis longis divaricatis simpliciusculis.)," Deut. Flora, **2**: 134–135. 1795.

FIGURE: Schrad., Jour. Bot. **1**: *pl. 3. f. 4.* 1799.

Sowerby, Eng. Bot. **27**: *pl. 1880.* 1808.

Fink, Lich. Minn. Contrib. U. S. Nat. Herb. **14**: *pl. 42.* 1910.

DIAGNOSIS: *Thallus* pendulous, brown, branches terete, *filiform throughout.* Apothecia brown.

DESCRIPTION: *Thallus* pendulous, filamentous, lax, terete, occasionally tortulous, brown to black, rarely paler; *cortex* glabrous or nitidous, often ruptured with white soralia; *primary branches* dichotomous, slender (max. length 38 cm.); *secondary branches* dichotomous, slender; *fibrils* capillaceous. *Apothecia* lateral, rare, very small (max. diam. 2 mm.), convex, innate-marginate, disk concolorous or pale brownish yellow. *Spores* as in *jubata.*

CONTINGENT PHASES: (*a*) Thallus entirely or partially gray (*Alectoria jubata subcana* Nyl. Jour. Bot. **14**: 360. 1876), (*b*) becoming virescent approaching *A. virens* Tayl., *A. tortuosa* Merr.?

SUBSTRATA: As in *jubata.*

GEOGRAPHICAL DISTRIBUTION: Common throughout the Transition and Boreal zones. It extends in the east from North Carolina (*Curtis*) to Labrador (*Cummings* and *Eckfeldt*); in the west from San Quintin, Lower California, to Yukon and Alaska

(*Cummings*), in which area it is rare. In the middle west it is found commonly from Wyoming, South Dakota, and Minnesota (*Fink*) northward. It is also found in the boreal swamps of the upper Austral zone.

OBSERVATIONS: Though this plant has been accepted recently as a full species intergrades are so common that it seems inadvisable to consider *implexa* other than a variety, particularly as it appears to be nothing more than a less rank, slender condition of *jubata,* which inhabits the regions of moderate rainfall and moisture. The branches in the typical examples of the variety are terete and uniformly slender, even from the proximal portions nearly to the apices. There is little suggestion of the coarse, remotely branched proximal portions changing almost abruptly into the capillaceous, tufted extremities so characteristic of true *jubata* and *fremontii,* and even *oregana.* No great difficulty presents itself in the separation of the variety from the species, especially for North American workers, as the rank, robust, typical *jubata* is replaced in our area by the following species for which in the majority of cases we have marked diagnostic characters. The eastern examples which are those most often fruited and esoraliate have been designated by Mr. Merrill (Bryologist 14: 36. 1911) as forma *minuscula,* but this is a name given to a condition of growth, and not in my opinion worth especial nomenclatural recognition. Moreover the plant originally described was esoraliate.

SPECIMENS EXAMINED

LABRADOR: Indian harbor, *A. C. Waghorne,* Sept. 7, 1891 (ANS); Blanc Sablon, *A. C. Waghorne,* July 21, 1893 (NH, CGS); ANTICOSTI: Gunn river, *Macoun,* July 29, 1883 (CGS). NEWFOUNDLAND: New harbor, *A. C. Waghorne,* 1890 (ANS); Exploits bay, *A. C. Waghorne,* (CEC); White bay, *A. C. Waghorne,* May 11, 1891 (CEC); (S); Notre Dame bay, *A. C. Waghorne,* 1893 (CGS). NOVA SCOTIA: Halifax, *J. W. Eckfeldt,* Aug. 4, 1890 (ANS); Truro, *Macoun,* June 12, 1883 (CGS); Cape Breton island, *Macoun,* July 9, 1898 (CGS). NEW BRUNSWICK: Cain river, *A. Fernald,* Oct., 1899 (1794 H); Grand

Menan, 1879 (NH, S). MAINE: No. East harbor, *R. W. Kelso,* 1906 (398 et 393 H); No. Haven, *Hopkins,* Jan. 1, 1906 (396 H); Southwest harbor, *S. Lurvey,* Aug. 19, 1909 (1705 H); Blanchard, *F. G. Blake,* Jan., 1909 (1120 H); Brunswick, *M. Copeland,* Jan., 1909 (1149 H); Rangeley, *C. P. Heffenger,* 1910 (1968 H); Bangor, *E. D. Merrill,* Apr. 23, 1896 (NH, UM); Portland, *A. H. Norton* (P); Portage, *R. W. Riddle,* Aug., 1907 (R); Orono, *E. D. Merrill,* May 23, 1896 (CEC). NEW HAMPSHIRE: Fitzwilliam, 1,000 ft., *R. H. Howe, Jr.,* July 31, 1910 (1922 H); Sandwich Dome, 3,500 ft., *W. S. Hinchman,* July 18, 1909 (1656 H); Mt. Madison, 4,000 ft., *T. T. McCabe,* Dec. 27, 1908 (1055 H); Mt. Clinton, 4,000 ft., *R. H. Howe, Jr.,* Sept. 22, 1908 (64 H); Randolph, *C. E. Cummings,* Aug. 3, 1889 (CEC); Plymouth, *C. E. Cummings,* May, 1891 (CEC). VERMONT: Mt. Ascutney, 3,000 ft., *R. H. Howe, Jr.,* Aug. 25, 1909 (1665 H). MASSACHUSETTS: Sudbury, *C. M. Carr,* Oct. 17, 1905 (395, 397 H); New Bedford, *H. Willey,* 1862–98 (NH); Amherst, *A. Clark,* 1875 (NH); Wellesley, *C. E. Cummings,* Dec., 1883 (W). NEW YORK: Catskill mts., *G. B. Kaiser,* Aug. 5, 1910 (SM); Adirondack mts., *C. H. Peck* (NY). NEW JERSEY: Budd's lake, *P. V. LeRoy,* Oct., 1871 (NY). PENNSYLVANIA: Delaware Co. (ANS). QUEBEC: Murray Bay, *D. P. Morgan,* Sept. 1, 1909 (1676 H); Fraser falls, Murray Bay river, Aug. 11, 1905; phase *a* (CGS); Shickshock mts., Aug. 26, 1883 (CGS); Montmorency river, June 30, 1905 (CGS). ONTARIO: Ottawa, *J. Macoun,* Oct. 19, 1899 (NH, CEC, 983 F); Nipigon river, *Macoun,* July 2, 1884 (CGS). KEEWATIN: *J. W. Tyrrell,* July 25, 1893 (CGS); Algonquin park, June 13, 1900 (CGS). LAKE SUPERIOR: *Mrs. Roy* (NY); *J. Macoun,* July 27, 1869 (NH); *E. Deser* (TH). MINNESOTA: Grand Portage island, *B. Fink,* June 18, 1897 (1869 H, 3182 F); Lake Superior, *E. Deser,* 1849 (S); Midway creek, *F. F. Wood,* Aug. 10, 1899 (ANS); Misquah hills, *B. Fink,* July 5, 1897 (NH, 3179 F); Current river, 1869 (CGS). MANITOBA: Porcupine mts., *Macoun,* July 21, 1881 (CGS). MONTANA: Roger's Ranch, *M. E. Jones,* Aug. 22, 1910 (1984 H). WYOMING: Shoshone lake, *J. M. Coulter,* 1872 (NH). COLORADO: Tusin lakes, *J. Wolf,* 1873 (ANS). IDAHO: Priest's lake, 660 m., *D. T. MacDougal,* Aug.

1, 1900 (NY); Lake Waha, 2,000 ft., *A. A. & E. G. Heller*, July 2, 1896 (B). LOWER CALIFORNIA: San Quintin (1983 H). CALIFORNIA: Santa Cruz pen., Black mts., 1,800 ft., *A. C. Herre*, Apr. 30, 1904, (1981 H); Santa Cruz mts., Castle Rock ridge, 2,500 ft., *A. C. Herre*, June 16, 1908 (1979 H). WASHINGTON: (?), *Brandegee* (S); Mt. Ranier, 6,000 ft., *T. C. Frye*, Aug. 11, 1904 (4855 F); Olympic mts., 5,000 ft., *T. C. Frye*, Aug. 14, 1907 (4818 F); (?), *W. W. Calkins* (W); Puget sd., Mt. Constitution, *B. Fink*, July 13, 1906 (5553 F); Friday harbor, *B. Fink*, June 28, 1906 (5613 F); Waldron island, *B. Fink*, July 10, 1906 (5552 F); San Juan island, *B. Fink*, July 27, 1906 (5429 F);* Mt. Ranier, 8,000 ft., *C. A. Mosier*, 1892 (NH). BRITISH COLUMBIA: Glacier, Hermit mt., 6,000 ft., *B. Fink*, Aug., 1906 (5865 F); Vancouver island, *W. Trelease*, June 2, 1899 (CEC); Skeena, *J. Macoun*, Oct. 2, 1891 (ANS); (?), *J. T. Rothcock*, 1865; Vancouver island, *J. Macoun*, May 10, 1893 (NH); Hectors, *J. Macoun*, Mar. 5, 1894 (4908 F); Vancouver island, Mt. Benson, *J. Macoun*, Oct. 7, 1893 (NY); Glacier, Lake Louise, 5,000 ft., *B. Fink*, Apr. 6, 1906 (5893 F); Victoria, *J. Macoun*, June 6, 1908 (W); Victoria, phase *a*, *Macoun*, May 6, 1893 (CGS); Vancouver island, May 7, 1875 (CGS); Hector, Aug. 5, 1904 (CGS); Vancouver island, Comox, *Macoun*, Apr. 30, 1887 (CGS); Donald, *Macoun*, July 3, 1885 (CGS); Mt. Benson, Vancouver island, *Macoun*, July 10, 1893 (CGS); Hastings, *Macoun*, Apr. 6, 1889 (CGS); Mt. Todd, 6,300 ft., *Dawson*, Sept. 17, 1888 (CGS). ALBERTA: Banff, *C. Crosby*, July 22, 1901 (5925 F); Banff, *Macoun*, July 24, 1891 (CGS); Jumping Pound Creek, *J. Macoun*, June 20, 1897 (CGS); Laggan, June 26, 1904 (CGS); Crow's Nest Pass, *J. Macoun*, Aug. 20, 1897 (CGS). BRITISH NORTH AMERICA: *Drummond* (TH); Lake Winnipegoosis, *J. Macoun*, 1882 (ANS). YUKON: Dawson, *R. S. Williams*, Oct. 2, 1898 (1858 H).

ALECTORIA FREMONTII Tuck. Proc. Amer. Acad. Arts & Sci. l. c.

TYPE: *Evernia Fremontii*, Tuck. MSS. Lich. Amer. sept. exsiccati, 3: no. 52. 1854.

* Contingent phase (*b*).

TYPE LOCALITY: "in montibus Californiae." "'Camp of Dec. 5, 6, 1854' (Sierra Nevada), 'California, abundant on Pines,' Col. Fremont (com. Torrey!). Hangs from the lower branches of all the coniferous trees of Northern California, and Southern Oregon."

ORIGINAL DESCRIPTION: "thallo filamentoso pendulo ramosissimo implexo tereti-compresso laevigato fusco-nigrescente, ramis inferioribus hic illic incrassatis lacunoso-excavatis flexuosis tortuosisque, superioribus apice tenuissimis, ultimis simplicibus; apotheciis innato-sessilibus ex urceolata denum planis margine tenuissimo evanido discum viridi-flavo-pruinosum cingenti," Proc. Amer, Acad. Arts & Sci. **25**: 422. 1858.

DIAGNOSIS: *Thallus* pendulous, reddish brown to black, branches compressed, sulciform and *foveolate, tortulous. Apothecia* and *soralia sulphureous.*

DESCRIPTION: *Thallus* pendulous, filamentous, pliant, subterete, or compressed, tortulous, reddish-brown to black, rarely pale; *cortex* glabrous or dull, sulciform and foveolate, occasionally with greenish or sulphurous soralia; *primary branches* compressed, remotely dichotomous (max. length 45 cm.); *secondary branches* dichotomous, slender, subterete; *fibrils* terete, capillaceous. *Apothecia* not uncommon, small (max. diam. 4 mm.), convex, innate, margin disappearing, disk pruinose, sulphureous. *Spores* $4–8 \times 4–5\mu$.

CONTINGENT PHASES: (*a*) Partially cinereous or pale-brown.

SUBSTRATA: Coniferous trees, occasionally on deciduous growths.

GEOGRAPHICAL DISTRIBUTION: Confined to the Transition and Boreal zones on the Pacific coast, extending from southern California (2,000 ft.) to southern Alaska (*Cummings*), east to Idaho, Wyoming, Montana and Alberta. In the Academy of Natural Sciences at Philadelphia is a specimen labelled from Maine, sent Dr. J. W. Eckfeldt by Mr. G. K. Merrill. It seems quite evident that in some way this specimen has become mislabelled.

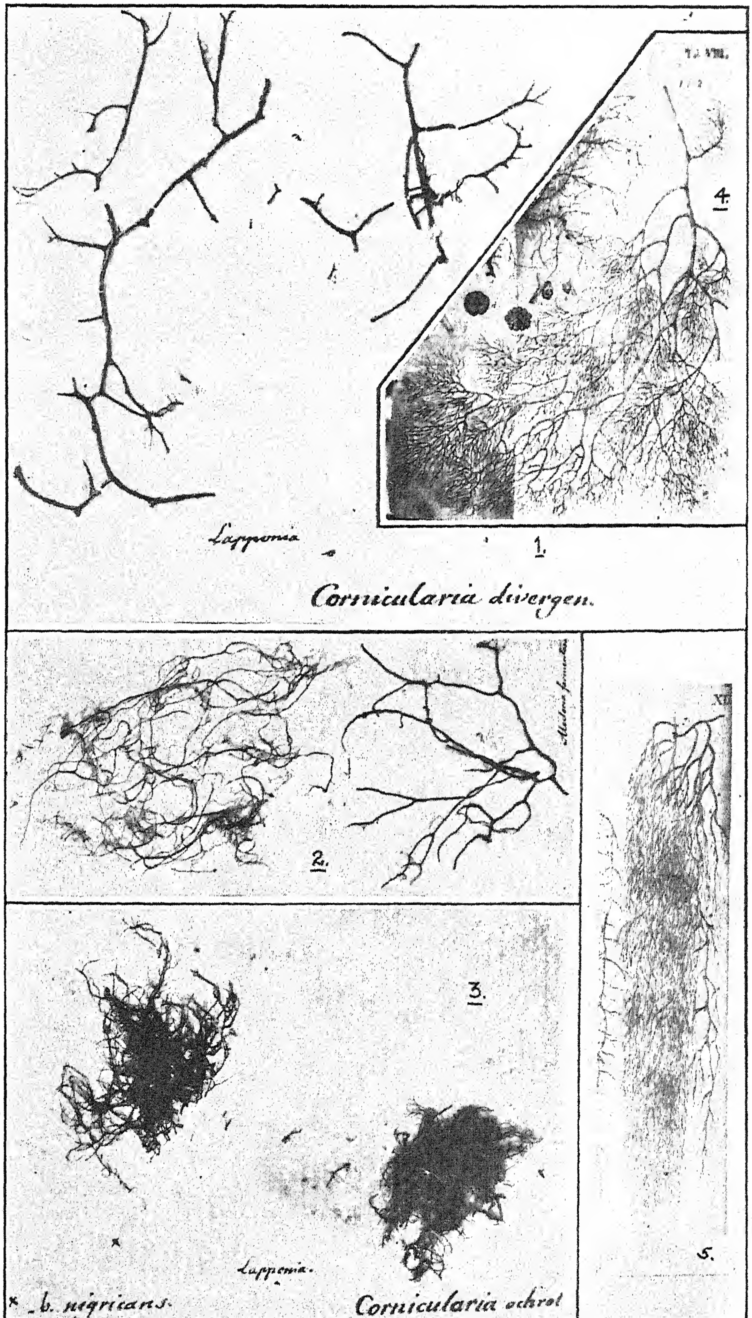
OBSERVATIONS: This species, no doubt a close *relative* of *jubata*, is, as has already been said, the most luxuriant *Bryopogon* of the *Alectorias* within our area. Its foveolate thallus and capillaceous extremities suggest strikingly *Usnea cavernosa* Tuck. Many of the plants attributed to *jubata* in reality belong here, and are placed elsewhere because they are sterile, and lack therefore

the diagnostic sulphureous disked apothecia. The soralia, however, though not common are just as characteristic, for so far as I have observed they are always yellow. In both true *jubata* and *implexa* they are white. It is evidently only the younger, efoveolate, esoraliate examples that are difficult to separate from *jubata*, and here the more tortulate condition of *Fremontii* is an aid.*

SPECIMENS EXAMINED

CALIFORNIA: San Jacinto mts., *H. E. Hasse*, 1893 (HEH, 1982 H, 4996 F); Tehachapi mts., 3,000 ft., *H. E. Hasse*, 1907 (1845 H); (?), *Mrs. Austin* (S); Sierra valley, *J. G. Lemmon* (S); Mt. Shasta, *M. A. Howe*, Aug. 5, 1904 (NY); (?), *E. J. Spence* (ANS); Mission Dolores, *E. Lehnest*, 1889 (ANS); Yosemite, *E. J. Spence*, Nov., 1882 (ANS); Sequoia Nat. Park, *W. Fry*, 1905 (NH); Round valley, 440 m., *V. K. Chestnut*, July 20, 1897 (NH); (?), *H. N. Bolander*, 1864 (NH); Sisson, *M. A. Howe*, July 24, 1894 (NH); Pedlar, 6,500 ft., *G. Hansen*, Oct. 3, 1894 (NH); *Fremont*, No. 52, *Tuck*. Amer. Sept. Exs. (TH). OREGON: Three Sister mts., *L. H. Mills*, Aug., 1910 (1929 H); Mt. Hood, *L. H. Larwood*, Feb. 18, 1907 (399 H); Central pt., *A. Ashworth*, Dec. 25, 1901 (7 SMC); Sanvier's island, *J. Howell* (S); Dallas, *T. Howell*, Oct. 30, 1882 (ANS); (?), *E. Hall*, Nov., 1880 (ANS); Mt. Hood, *T. Howell*, Oct. 30, 1882 (ANS); Minam river, 2,900 ft., *E. P. Sheldon* (NH); (?), Cusick (NH); (?), *E. Hall*, 1871 (NH); Mt. Hood, *J. W. Eckfeldt*, 1880 (CGS). WASHINGTON: Spokane, *J. F. Brownlee*, Sept. 15, 1902 (389 H); Spokane, *B. Labaree*, Dec. 27, 1908 (999 H); Goldendale, *A. S. Foster*, Dec. 20, 1909 (940 SMC); (?), *W. N. Suksdorf* (S, NH); Medical lake, 2,900 ft., *T. K. Richards*, Jan., 1911 (2000 H); Goldendale, *A. S. Foster*, Oct. 20, 1909 (R); (?), *W. W. Calkins* (3009 CM). IDAHO: Hayden lake, 2,200 ft., *T. K. Richards*, Aug. 10, 1909 (1614 H); (?), *A. I. Mulford*, July, 1892 (NY); Lake Waha, 2,000 ft., *A. A. & E. G. Heller*, July 3, 1896 (NY); Lake Pend d'Orielle, *J. B. Lieberg*, 1890 (ANS); Latah Co., *C. V. Piper*, June 16, 1893 (CEC). MONTANA: Columbia Falls, *R. S. Williams*, Apr., 1893 (Lich. Bor. Amer. No.

* "med gule soredier," Lynge, De Norske busk- og blad laver, Bergens Mus. Aarbog 9: 62. 1910 and Stizenberger l. c. 130 = "Soredien gelblich."



SPECIES OF ALECTORIA

17, Dec. No. Amer. Lich. No. 54); Columbia Falls, *R. S. Williams,* May 8, 1897 (1869 H); Missoula, *M. J. Elrod,* 1899 (1870 H); Stanton mt., 1,800 m., *F. K. Kreeland,* Aug. 30, 1908 (NY); Columbia Falls, *R. S. Williams,* May 31, 1895 (NH); Missoula, *M. J. Elrod,* 1899 (3176 F); Hayden creek, *M. J. Elrod* (4947 F); Warm springs, *L. H. Pammel,* 1904 (4667 F). BRITISH COLUMBIA: Deer Park, *J. Macoun,* June 3, 1890 (NH); Selkirk mts., 4,300 ft., *H. Petersen,* June 29, 1904 (NH); Glacier, Fairview mt., 4,000 ft., *B. Fink* (5900 F, 612 SMC); Sotewert's lake, June 20, 1875 (CGS); Lower Arrow Lake, *Macoun,* June 3, 1890 (CGS); Lecamous, *Macoun,* July 7, 1889 (CGS). ALBERTA: Canadian Rocky mts., *G. Martin,* Aug., 1909 (1806 H). BRITISH NORTH AMERICA: *Drummond* (TH). ?MAINE: Square lake, *G. K. Merrill,* Feb., 1884 (ANS).

SECT. II.: EUALECTORIA Th. Fr. Lich. Scand. 19. 1871.

Asci containing 4 (rarely 2) brown spores. Thallus light. Medulla arachnoid or absent.

ALECTORIA NIGRICANS (Ach.) Nyl. Lich. Scand. 71. 1861

Cornicularia ochroleuca nigricans Ach. l. c.

TYPE: Not indicated, but the specimen on which the species was based is in the Acharian herbarium at Helsingfors, fide *Elfving.*

TYPE LOCALITY: "in alpibus borealis Sueciae."

ORIGINAL DESCRIPTION: "thallo scabriusculo sordide fuscescente vel nigricante ad basin palidiori ramis ramulisque implexis nigris." Ach. Lich Univ. 615. 1810.

FIGURE: Nyl. Synop. *pl. 8. f. 17.* 1858–60.

DIAGNOSIS: *Thallus smaller* and more *slender* than in *ochroleuca,* branches attenuate, *chestnut,* apices *purplish*-black.

DESCRIPTION: *Thallus* erect, Cladoniform, rigid, rarely foveolate, branches slender, subterete, proximal portions chestnut, apices livid to blackening; *cortex* glabrous to dull, rarely papillate or striate; *primary branches* dichotomous, fruticulose, (max. length 10 cm.); *secondary branches* dichotomous; *fibrils* entangled, frutescent, furcate, attenuate. *Apothecia* as in following species (max. diam. 3 mm.). *Spores* (often 2 nae.) 21–35 × 15–20μ.

SUBSTRATA: On rocks, humus, mosses, rarely (?) on trees.

GEOGRAPHICAL DISTRIBUTION: Confined to the Boreal zone. It

has been recorded on the Atlantic coast from Maine (*Eckfeldt*) to Greenland (*Macoun, Stizenberger*), and at the following intermediate stations: Quebec (*Macoun*), Miquelon island (*Stizenberger*), Newfoundland (*Eckfeldt, Stizenberger, Arnold*), Hudson bay (*Macoun*), Labrador (*Arnold, Cummings, Eckfeldt, Macoun, Townsend & Allen*) and Baffin's bay (*Stizenberger*). On the Pacific coast it is reported from British Columbia (*Macoun*) to Alaska (*Hue, Rothcock, Cummings, Stizenberger*). In addition to these localities I have seen specimens from Melville island, Ungava and Keewatin.

OBSERVATIONS: Though this plant appears to be only a smaller, more slender color variety of *ochroleuca,* yet it has the unique property of conveying after a time a purplish tinge* to the herbarium envelopes, perhaps due to iodine† which is known to occur in some [marine] algae. When only a few filaments of its thallus have been gathered with *ochroleuca,* they indicate their presence by tinging just beneath them the paper on which they lie. This property offers the best diagnostic characteristic for the ready determination of long preserved‡ herbarium material. Its structural differences give sufficient grounds for its recognition as a full species. *Alectoria Thulensis* Th. Fr. (Lich. Arctoi, 28. 1860) which has been recorded from our area is the present species under a synonymous name.

SPECIMENS EXAMINED

NEWFOUNDLAND: *A. C. Waghorne,* 1892 (ANS); *M. A. Curtis* (NH); (S). LABRADOR: Blanc Sablon, *A. C. Waghorne,* 1894 (NY, NH); Seal harbor, *A. C. Waghorne,* Aug. 12, 1891 (ANS); Blanc Sablon, *A. C. Waghorne,* July 24, 1893 (CEC); Clearwater lake, *A. P. Low,* July 12, 1896 (CGS). UNGAVA: Mansfield island, *R. Bell,* Aug. 30, 1884 (CGS). GREENLAND: *Gischa* (TH); Christianshaab (NH). QUEBEC: Shickshock mts., *Gaspe,* Aug. 26, 1882 (CGS). FRANKLIN: Melville island, *E. Parry*

* Arnold: "Das Papier der beiden Umschlagebögen ist dort, wo die Flechte liegt, braun-röthlich gefärbt." Lich. Fragm. Oesterr. bot. Ztschr. 44: 2. 1894, and Crombie: Brit. Lich. 211. 1894.

† Found in sea water and mineral springs.

‡ Ten years or more.

(TH). KEEWATIN: Marble island (CGS). ALASKA: Pt. Barrow, *E. Leynest* (ANS); Unalaska island, *J. H. Bean*, Oct. 1, 1880 (NH); Cape Nome, *W. A. Setchell*, July 25, 1899 (CEC); St. Michaels, *L. M. Turner*, Oct. 11, 1875 (CEC); St. Michaels, *W. A. Setchell*, July 19, 1899 (CEC); St. Paul's island, *J. M. Macoun*, June 19, 1897 (CGS); St. George island, *J. M. Macoun*, June 7, 1897 (CGS). BRITISH COLUMBIA: Summit Gold Range, *Macoun*, Aug. 10, 1889 (CGS).

ALECTORIA OCHROLEUCA (Ehrh.) Nyl. Prod. Lich. Gall. et Alg. Act. Soc. Linn. Bord. **1**: 292. 1856, separate 46. 1857

Lichen ochroleucos Ehrh. l. c.

TYPE: Not indicated, but the specimen on which the species is based may possibly be found in Erhart's herbarium at Göttingen, or at Leipzig or Moscow, though I have been unable to definitely locate it.

TYPE LOCALITY: Not mentioned.

ORIGINAL DESCRIPTION: "dichotomo-ramosus, teres, erectiusculus, inarticulatus, inanis, ochroleucos; ramis divaricatis: apicibus furcatis, nigris." Ehrh. Beitrage zur Naturkunde, 3: 82. 1788.

FIGURE: Hoffm. Descript. adum. Lich. *pl. 26. f. 2*, and *pl. 68. f. 5–7*.

Sowerby, Eng. Bot. 33: *pl. 2374*. 1812.

DIAGNOSIS: *Thallus erect*, Cladoniform, branches rigid, apices *blackening*.

DESCRIPTION: *Thallus* erect, Cladoniform, rigid, often sulciform or foveolate, branches subterete, proximal portions virescent to stramineous, apices blackening; *cortex* glabrous, dull, papillate or striate; *primary branches* dichotomous, fruticulose (max. length 15 cm.); *secondary branches* dichotomous; *fibrils* entangled, frutescent, ramulous, apices furcate. *Apothecia* subterminal or lateral, rare, large (max. diam. 8 mm.), concave or applanate, at length convex, innate-marginate, margin disappearing and lacerate, disk chestnut. *Spores* 18–48 $\times$ 13–28μ.

CONTINGENT PHASES: (*a*) concolorous, divaricate (?f. *tenuior* Crom. Jour. Bot. **10**: (1) 232. 1872).

SUBSTRATA: On the earth.

GEOGRAPHICAL DISTRIBUTION: Confined to the Boreal zone. It has been reported from Maine (*Eckfeldt*), Quebec (*Macoun*),

Newfoundland (*Eckfeldt, Macoun, Arnold*), Labrador (*Eckfeldt, Macoun*), and Greenland (*Stizenberger, Macoun*) on the east coast, and from Vancouver (*Macoun*) to Alaska (*Cummings*) on the Pacific. In the interior it has been recorded from Great Bear Lake (*Leighton*), and I have seen specimens from the Yukon, Baffin land, Hudson bay and Hudson strait, Quebec and Keewatin. It has also been reported from Mt. Orizaba, Mexico, by Nylander. The Maine record seems in view of its range somewhat doubtful.

OBSERVATIONS: This plant has been cited both as *Alectoria ochroleuca* and *Alectoria ochroleuca rigida* (Vill.) Fr. The names are, however, synonymous, the former having priority. I have not seen a fertile example from our area, though fruited European specimens are not uncommon. It is easily distinguished by its erect growth,—suggesting slightly *Cladonia rangiferina* (L.) Web. The name *ochroleuca* has so long stood, as in the case of *jubata* and *barbata,* for a sectional rather than a specific concept, that even in as recent a work as Miss Cummings' "Lichens of Alaska" it is cited as well as the variety *rigida,* following the Tuckerman arrangement. Miss Cummings' key distinction limited the concolorous plants to *ochroleuca,* those "blackening at the tips" to the var. *rigida.* The original description of *ochroleuca,* however, reads "apice furcatis, nigris," and it seems that only the younger plants are concolorous.

SPECIMENS EXAMINED

LABRADOR: Black bay, *W. Palmer,* Aug. 5–6, 1887 (NY, NH); Battle harbor, *A. C. Waghorne,* Aug. 25, 1891 (CEC); Forteau, *A. C. Waghorne* (NH); *A. P. Low,* July 18, 1896 (NH); Clearwater Lake, *A. P. Low,* July 12, 1896 (CGS). QUEBEC: Shickshock mts., Gaspe, Aug. 26, 1882 (CGS). KEEWATIN: *T. W. Tyrrell,* July 28, 1893 (CGS). UNGAVA: Hudson bay, *A. P. Low,* Aug. 20, 1904 (4905 F); Mansfield island, *Dr. Bell,* Nov. 7, 1885 (1278 CM); Hudson strait, *R. Bell,* July, 1897 (CGS); Nottingham island, *R. Bell,* 1884 (CGS); Cape Chudleigh, *R. Bell,* Aug. 8, 1884 (CGS); Hudson bay, *A. P. Low,* Aug. 20, 1904 (CGS). GREENLAND: Pt. Foulke, *I. I. Hayes,* 1861 (ANS); *Holboll* (NY); Auk pen., *W. H. Burk,* 1891 (1812 H). FRANK-

LIN: Baffin land, *Dr. Lyall*, Aug., 1854 (1865 H). ALASKA: Unalaska, June, 1899 (CEC); Prince William sound, *F. V. Coville*, June 24, 1899 (CEC); Kadiak island, *W. Trelease*, July 2, 1899 (CEC); St. Michaels, *C. Wright*, 1880 (ANS, NH); *W. H. Dall*, 1874 (ANS); *W. H. Dall*, 1874 (NH); Unalaska, *W. A. Setchell*, June, 1899 (CEC); St. Michaels, *W. A. Setchell*, July 19, 1899 (CEC); St. Michael's island, *L. M. Turner*, Sept., 1875 (CEC). YUKON: *I. C. Russell*, July 28, 1889 (NH); near Dawson, *R. S. Williams*, Apr. 2, 1899 (1861 H). BRITISH NORTH AMERICA: *Drummond* (TH). ARCTIC OCEAN: *Franklin's* 1st Voyage (TH); Koby sound, *Beechy* (TH).

ALECTORIA OCHROLEUCA CINCINNATI (Fr.) Nyl. Synop. 282. 1858–60

Evernia ochroleuca cincinnati Fr. l. c.

TYPE: not indicated; the specimen on which the species is based is not preserved at Upsala, where all Fries' collections are, fide *Prof. O. Juel*.

TYPE LOCALITY: not indicated.

ORIGINAL DESCRIPTION: "thallo sarmentoso complicato rigidulo ochroleuco, apices concoloribus," Fries, Lich. Eur. reform. 22. 1831.

FIGURE: Sowerby, Eng. Bot. **29**: *pl. 2040.* 1809(?).

Hornem, Fl. Dan. **11**: *pl. 1897. f. 1.* 1828.

DIAGNOSIS: *Thallus prostrate, rigid,* subterete, *foveolate* or *cavernous, virescent.*

DESCRIPTION: *Thallus* prostrate, rigid, branches terete to compressed, virescent, occasionally blackening; *cortex* glabrous, dull, papillate or striate, foveolate or cavernous; *primary branches* remotely dichotomous, subterete or compressed, tortulous, occasionally monstrous (max. length 35 cm.); *secondary branches* subremotely dichotomous, subterete, tortulous; *fibrils* rare, subcapillaceous, terete. *Apothecia* rare, as in *sarmentosa. Spores* as in *ochroleuca.*

CONTINGENT PHASES: (*a*) clothed more or less with short (2 mm.) spines.

SUBSTRATA: On the earth and rocks.

GEOGRAPHICAL DISTRIBUTION: Confined to the Boreal zone. It has been reported from the White mts. (*Tuckerman*) to Green-

land (*Hue, Stizenberger, Macoun*) on the east coast. On the west coast from Oregon (*Stizenberger*) to Alaska (*Macoun, Cummings*). Other stations are: Washington (*Roell*), Quebec (*Macoun*), Newfoundland (*Tuckerman, Macoun, Eckfeldt, Stizenberger, Arnold*), Hudson bay (*Macoun*), Miquelon island (*Stizenberger*), Davis strait (*Stizenberger*), Labrador (*Arnold*), and Ungava.

OBSERVATIONS: That this variety is little understood by most students, is evidenced by the varied examples referred to it in herbaria. The fact that it has been called both a variety of the erect *ochroleuca* and the pendulous *sarmentosa* shows also that its classification has been difficult. This condition of affairs is not to be wondered at as Fries' original description if taken alone is not at all diagnostic, nor does it mention what has long been accepted as its most diagnostic feature, *i. e.*, a foveolate thallus. The loss of the type may have also aided in the dilemma. It is unquestionable that Tuckerman, a close follower of Fries, properly understood the plant, and he used the four diagnostic terms: "prostrate," "rigid," "dilated," "lacunose." Nylander also called it "prostrato," "compresso crassiore," "magis lacunoso vel lacunis." Th. Fries "prostratus," "rigidulus," "scobiculato-foveolatus." As Fries placed it between his "fruticuloso" *ochroleuca* and his "pendulo" *sarmentosa*; and as it seems to be a transitional variety spanning the gap between the reduced, caespitose, boreal *ochroleuca* and the more luxuriant, pendulous, subboreal *sarmentosa* it should be naturally considered a variety of the former, the first of the three plants described. Moreover *sarmentosa* and *cincinnati* show absolutely no intergradation where their ranges meet.

NOTE: *Alectoria luteola* DeN. ex Del. Giorn. Bot. 2: Pl. I, Tom. I. 206. 1846. Reported from Newfoundland by Stizenberger, l. c. 125, and originally described as follows:

"*Alectoria luteola* Delis, herb!

"*Evernia luteola* Montagn. herb!

"Trovasi a Terra nuova nell' America settentrionale, secondi esem plari del chiarissimo Montagne, e dell' erbario dello stesso Delise favoritimi dall'illustre Lenormand,

"Tallo filiforme lunghissimo di color giallo pallido, levigato,

tenace, semitrasparente; rami di dicotomia in dicotomia assottigliati, gli ultimi capillari. Apoteci laterali, sessili, orbicolari od allungati, piano-convessi, di due millimetri di diametro, di color fosco nereggiante nel disco. Sporidii ellittico-rotondati di tre in quattro centimillimetri di lunghezza, di color castagno fosco, quasi visibili ad occhio nudo."

SPECIMENS EXAMINED

LABRADOR: Fox Harbor, *A. C. Waghorne,* Sept. 16, 1891 (NY); Black Bay, *W. Palmer,* Aug. 5, 1887 (NY). UNGAVA: Diggs island, *R. Bell,* 1885 (CGS). GREENLAND: (NY). ALASKA: Unalaska, *W. A. Setchell,* June, 1899 (CEC); Unalaska, *J. H. Bean,* Oct. 1, 1880 (NH); Cape Nome, *W. A. Setchell,* July, 1899 (NH).

ALECTORIA OSTEINA Nyl. Flora l. c.

Alectoria ochroleuca f. *osteina* Nyl. Synop. l. c.

TYPE: No. 6947, coll. Galeotti.

TYPE LOCALITY: Mt. "Orizaba, altit. 10,000 ped.," Mexico.

ORIGINAL DESCRIPTION: "sistere meam *A. osteinam Cornicularia laeta* Tayl. . . ., *C. lata* Tayl. . . . ; sed nil neque laetum, neque latum habet haec species," Flora **41**: 378. 1858.

"Variat dein forma minore *osteina* Nyl. . . . thallo magis albido," Synop. 282. 1858–60.

DIAGNOSIS: *Thallus erect,* pale *virescent,* branches rigid *slender,* subterete, and *Cladoniform.*

DESCRIPTION: *Thallus* erect, rigid, subterete, *Cladoniform, pale* virescent; *cortex* glabrous, dull, striate; *primary branches* subterete, slender, dichotomous (max. length 6 cm.); *secondary branches* terete, slender, dichotomous; *fibrils* terete, minutely slender, furcate. *Apothecia* small (max. diam. 1.5 mm.), concave, innate, margins entire, incurved, disk chestnut to dark brown. *Spores* as in *ochroleuca.*

SUBSTRATA: on the earth.

GEOGRAPHICAL DISTRIBUTION: Mexico, Mt. Orizaba and Toluka (*Stizenberger*).

OBSERVATIONS: This plant appears to be a reduced slender, alpine form otherwise strongly resembling *ochroleuca,* of which by Nylander himself it was once considered a form. I have only been able to examine one authentic specimen (TH) from our

area, and am therefore unable to give it sufficient study to add anything to its history. The apices of the branches of the specimen examined are punctate with dark spermogones.

ALECTORIA SARMENTOSA (Ach.) Lich. Univ. 595. 1810

Lichen sarmentosus Ach. l. c.

TYPE: not indicated, but the specimen on which the species was based is in the Acharian herbarium at Helsingfors, fide *Elfring*.

TYPE LOCALITY: "Bjorko, Roningaholm &c. Somalandiae."

ORIGINAL DESCRIPTION: "filamentosus, nudus, diffusus, dichotomus, fistulosus, lacunosus; loris sarmentosis, apice ramosissimis, capillaceis implexis," Ach. Kong. Vet. Act. Nya Handl. **16**: 212. 1795.

FIGURE: [Dill. Hist. Musc. *pl. 13. f. 15.* 1841.]

Ach. l. c. *pl. 8. f. 2.*

Hoffm. Descript. adum. Lich. *pl. 72. f. 1–3.* 1801.

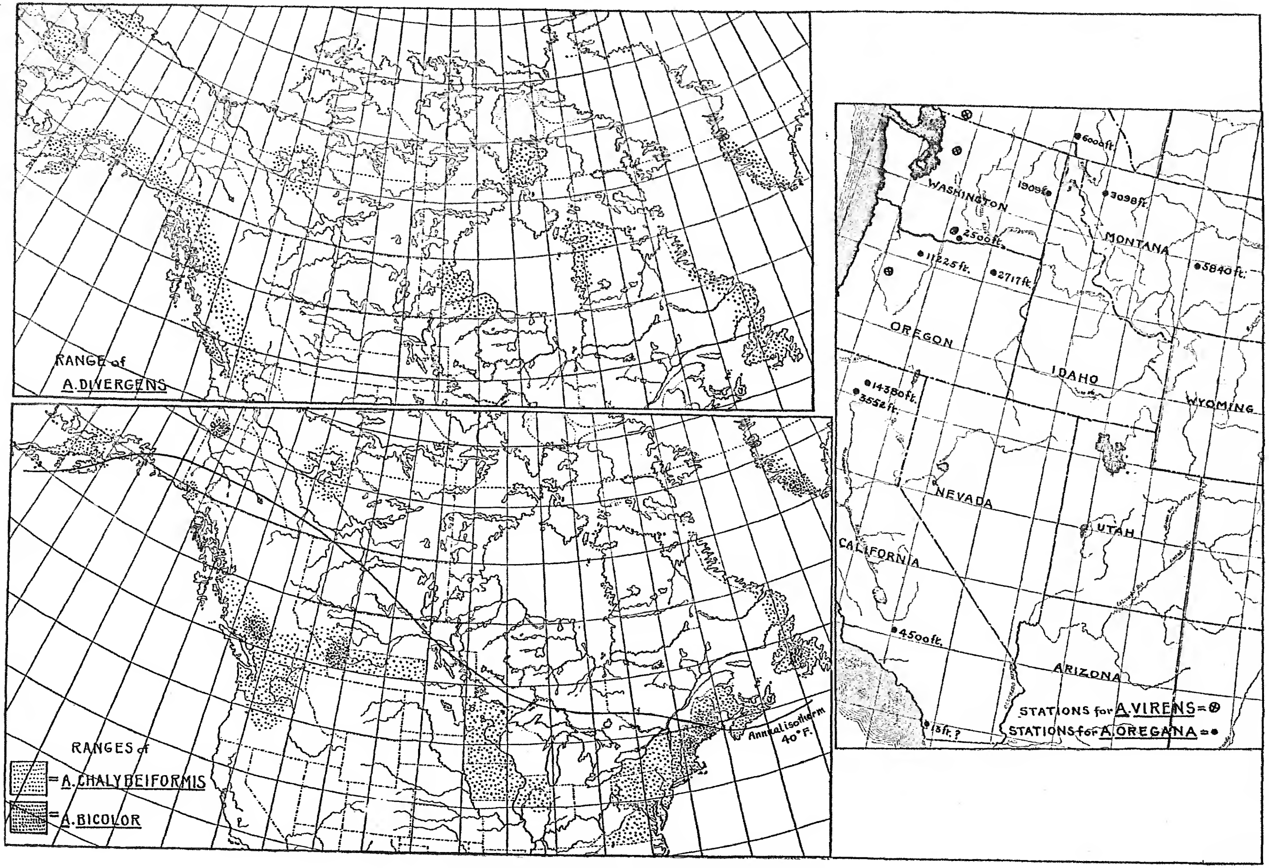
DIAGNOSIS: *Thallus pendulous,* pliant, subterete, glabrous, *stramineous* to *virescent.*

DESCRIPTION: *Thallus* pendulous, pliant, branches terete to compressed, stramineous to virescent, occasionally blackening; *cortex* glabrous, dull, striate, often sulciform; *primary branches* remotely dichotomous, subterete to compressed, tortulous (max. length 45 cm.); *secondary branches* subremotely dichotomous, subterete, tortulous; *fibrils* capillaceous, terete. *Apothecia* not uncommon, medium (max. diam. 3 mm.) lateral, innate-marginate, margins disappearing, disk dark brown, chestnut or pale yellow. *Spores* as in *ochroleuca.*

CONTINGENT PHASES: (*a*) clothed more or less with short (2 mm.) spines.

SUBSTRATA: On trees, generally conifers.

GEOGRAPHICAL DISTRIBUTION: Confined to the upper Transition and lower Boreal zone. It has been recorded from New Hampshire (*Tuckerman*) to Greenland (*Macoun, Stizenberger*) on the Atlantic coast, though I have seen only reduced examples from as far north as Newfoundland. The intermediate records are Maine (*Eckfeldt*), Cape Breton (*Macoun*), Anticosti (*Macoun*), Newfoundland (*Eckfeldt, Arnold*), Labrador (*Eckfeldt, Macoun, Cummings*). Dr. Eckfeldt has also recorded it from New Jersey,



MAPS SHOWING DISTRIBUTION

but this would be an isolated, unusual, and it would seem doubtful locality. On the Pacific coast it has been recorded from Oregon (*Tuckerman*) to Alaska (*Cummings, Macoun*). Other Pacific coast records are Washington (*Tuckerman*), British Columbia (*Macoun*) and Sitka (*Rothcock*). In addition to these localities I have examined specimens from New Brunswick, Miquelon island in the east; from Mexico, Mt. Oaxaca, Mt. Orizaba, northern California, Idaho, Montana, Saskatchewan, Alberta and Yukon in the west.

OBSERVATIONS: Either Acharius' *sarmentosa* or Hoffmann's *dichotoma* are applicable to this plant, as both names were given to it in the year 1795. As *sarmentosa* has long stood, it seems, however, advisable as a nomina conservanda to always consider *dichotoma* a synonym. An examination of the original descriptions and figures will show that Acharius evidently had in his possession a more sulciform specimen than Hoffmann. Wainio in his report on the Hoffmann herbarium called the German plant = to Acharius' *sarmentosa*. The rigidity of the thallus is not a particularly good character for separation from the foregoing variety, nor are the branches terete in one and in the other compressed. The subboreal, pendulous, tree growing species, either stramineous, virescent or occasionally blackened does not intergrade into the boreal, prostrate, *cavernous,* earth growing, always virescent variety of the former species.

NOTE: *Alectoria crinalis* Ach. Lich. Univ. 594. 1810. This form has been recorded from Labrador and Newfoundland by Arnold (Lich. Fragm. l. c. 1894–1896). This seems to represent a tangled, filiform phase of the above species. It was described as follows: "thallo subcompresso ramosissimo cinerascente fragilissimo, lorulis filiformibus superne teretiusculis; apotheciis? convexis fuscis." Suecia.

SPECIMENS EXAMINED

MAINE: Blanchard, *F. S. Blake,* Jan., 1909 (1122, 1112 H); NEW BRUNSWICK: Grand Manan, *H. Willey,* 1879 (NH). NOVA SCOTIA: Port Mulgrave, *Barclay* (TH); Baddeck, *Macoun,* July 28, 1898 (CGS). ANTICOSTI: Salt Lake, *Macoun,* Aug. 10,

1883 (CGS). NEWFOUNDLAND: Miquelon island, *E. Delamare* (NY); *S. Dennis*, Mar. 13, 1863 (TH); Leading Tickle, *A. C. Waghorne*, May 11, 1893 (NY, CEC, CGS); Notre Dame bay, *A. C. Waghorne*, Oct. 5, 1893 (NY); Shoal harbor, *A. C. Waghorne*, Dec. 18, 1891 (1278 CM); Notre Dame bay, *A. C. Waghorne*, Jan. 5, 1893 (NY); Bay of Islands, *C. D. Howe*, Aug. 10, 1901 (1873 H); *A. C. Waghorne*, Apr. 4, 1894 (CEC). MEXICO: Mt. Oaxaca, 9,000 ft., *C. G. Pringle*, June 3, 1894 (R). CALIFORNIA: *E. J. Spence* (ANS); Sisson, *M. A. Howe*, July 24, 1894 (NY, NH). OREGON: Mt. Hood, *A. S. Foster*, June 20, 1907 (459 SMC); Cascade mts., *C. G. Pringle* (S, CEC); Sanvier's island, *J. Howell* (S); Wallowa mts., 5,100 ft., *E. P. Sheldon*, Sept. 21, 1897 (NH); *E. Hall*, 1871 (NH); Coast Range, *A. R. Sweetser*, July 18, 1899 (NH); Mt. Hood, 3,000 ft., *T. C. Frye*, Aug. 28, 1907 (4833 F); Wallowa mts., 5,100 ft., *E. P. Sheldon*, Sept. 29, 1897 (W); Cascade mts., *C. G. Pringle*, Sept. 22, 1881 (W); Three Sister mts., *L. H. Mills*, Aug., 1910 (1931 H); Mt. Hood, 3,000 ft., *A. S. Foster*, June 20, 1907 (401 H); Carlton, 500 ft., *L. H. Mills*, 1909 phase (*a*) (1641 H); Mt. Hood, *J. W. Eckfeldt*, 1880 (CGS). WASHINGTON: Liberty creek, *T. A. Bonser*, May, 1908 (731 SMC); Colville region, *W. M. Cranby* (ANS); Mt. Ranier, *C. A. Mosier*, 1892 (NH); Olympic mts., 5,000 ft., *T. C. Frye*, Aug. 14, 1907 (4784 F); *W. W. Calkins* (3009 CM, 985 F); Mt. Ranier, 5,000 ft., *T. E. Frye* (4764 F). IDAHO: Priest lake, 1,800 ft., *D. T. MacDougal*, July 27, 1900 (NY); Lake Pend d'Orielle, *J. B. Leiberg*, 1890 (NY); Chilco pass, Kootnai Co., 4,000 ft., *J. B. Leiberg*, 1889 (ANS); *G. E. Tower*, 1902, no. 13 Lich. Exs. Merrill (1825 H); *J. B. Leiberg* (NH); Hayden lake, 2,200 ft., *T. K. Richards*, Aug. 10, 1909 (1613 H); Coeur d'Alene river, 4,000 ft., *T. K. Richards*, Aug. 16, 1909 (1612 H). MONTANA: Sin-Yah-a-min lake, 3,000 ft., *W. P. Harris*, June 21, 1901 (9 SMC, NY); Long ridge, 6,150 ft., *W. P. Harris*, July 10, 1901 (10 SMC, NY); *F. L. Liser*, Aug. 18, 1893 (NH). BRITISH COLUMBIA: Lake Nipigon, *J. Macoun*, 1884 (NY, CEC); Queen Charlotte island, *Tracy Boas*, 1901 (NY); Emerald lake, 4,300 ft., *H. Patterson*, June 30, 1894 (NH, CM); Glacier, Mt. Fairview, 5,000

ft., *B. Fink,* Aug., 1906 (5867, 5870, 5913 F); Yoho pass, *J. Macoun,* Aug. 6, 1904 (4879 F); Revelstoke, 2,000 ft., *C. E. Shaw,* July 9, 1905 (3563 CM); Puget sound, Mt. Constitution, *B. Fink,* July 13, 1906 (5581, 5547, 5498 F; 1544, 1895 H); Turtle Back mt., *B. Fink,* July 30, 1906 (5425 F); Glacier, *B. Dean,* June, 1896 (NY); *W. W. Calkins* (W); Vancouver island, *W. Trelease,* June 2, 1899 (CEC); *Hossack,* 1909 (2006 H); New Westminster, *A. J. Hill,* 1906 (1547 H); (?) 100 ft., *L. H. Mills,* Sept. 1, 1909 (1687 H); Barclay sound, *J. Macoun,* 1909 (1777 H); Columbia valley, *J. Macoun* (970 H); Friday harbor, *B. Fink,* July 7, 1906 (1060 H); Donald, *Macoun,* July 6, 1885 (CGS); Selkirk mts., *Macoun,* Aug. 8, 1890 (CGS); Vancouver island, *Macoun,* Apr. 30, 1887 (CGS); Skeena river, *J. M. Macoun,* Oct. 2, 1891 (CGS); Revelstoke, *Macoun,* May 5, 1890 (CGS); Yoho pass, Sept. 8, 1904 (CGS); Burrard inlet, *Macoun,* Apr. 24, 1889 (CGS); McLeod's lake, June 27, 1875 (CGS). ALBERTA: Laggan, 5,000 ft., *C. Crosby,* July 22, 1901 (5912 F); Rocky mts., 6,000 ft., *G. Martin* (1805 H); Kicking Horse pass, *Macoun,* Sept. 13, 1884 (CGS). SASKATCHEWAN: Moose mt., 6,000 ft., *J. Macoun,* June 30, 1897 (CGS). ALASKA: Unalaska, *W. A. Setchell,* June, 1899 (CEC); Indian river, Sitka, *G. E. Cooley,* Aug. 12, 1891 (NY); Skeena, *J. Macoun,* Oct. 2, 1891 (ANS); Prince William sound, *A. W. Greeley,* Aug., 1902 (NH); Prince William sound, *C. W. Hayes,* Sept., 1891 (W. CEC); Indian river, *G. E. Cooley,* Aug. 12, 1891 (W); Sitka, *L. J. Cole,* June 15, 1899 (CEC); New Metlakahtla, *W. Trelease,* June 4, 1899 (CEC); Yakutat bay, *W. Trelease,* June 22, 1899 (CEC); Sheep creek, *G. E. Cooley,* Aug. 5, 1891 (CEC); *F. V. Coville,* June 5, 1899 (CEC); Port Etches, *J. M. Macoun,* June 18, 1892 (CGS). YUKON: Chilcoot pass, *R. S. Williams,* Apr. 6, 1898 (1859 H).

ALECTORIA VIRENS Tayl.* l. c.

Alectoria tortuosa Merrill, Bryologist, **12**: 5. 1909.

TYPE: In the Taylor herbarium, Boston Society of Natural History, Boston, Massachusetts.

* Müll. Arg. 74: 373. 1891 "Ex omni analogia et naturali affinitate congenerica esse debet cum *A. ochroleuca.*"

TYPE LOCALITY: Sheopore, East Indies, Wallick, January, 1821.

ORIGINAL DESCRIPTION: "thallo pendulo, elongato, filiformi, tereti-compresso, subdichotomo, implexo, pallide virenti, hinc canaliculato, ad angulos compresso, ramulis ultimis setaceis, flexuoso-curvatis, apice nigricantibus; gemmis in thalli canaliculo pulveraceis, concoloribus; apotheciis minutis, convexis, fuscis, immarginatis," Hook. Jour. Bot. 6: 188. 1847.

DIAGNOSIS: *Thallus pendulous,* pliant, *sulpho-virescent,* branches subterete, dull, *tortulous.*

DESCRIPTION: *Thallus* pendulous, pliant, branches subterete to compressed, tortulous, sulpho-virescent (more or less washed with brown); *cortex* dull, sparingly striate (in the type longitudinally split); *primary branches* subremotely dichotomous, more or less tortulous (max. length 20 cm.); *secondary branches* dichotomous, somewhat tortulous; *fibrils* capillaceous, terete. *Apothecia* not observed.

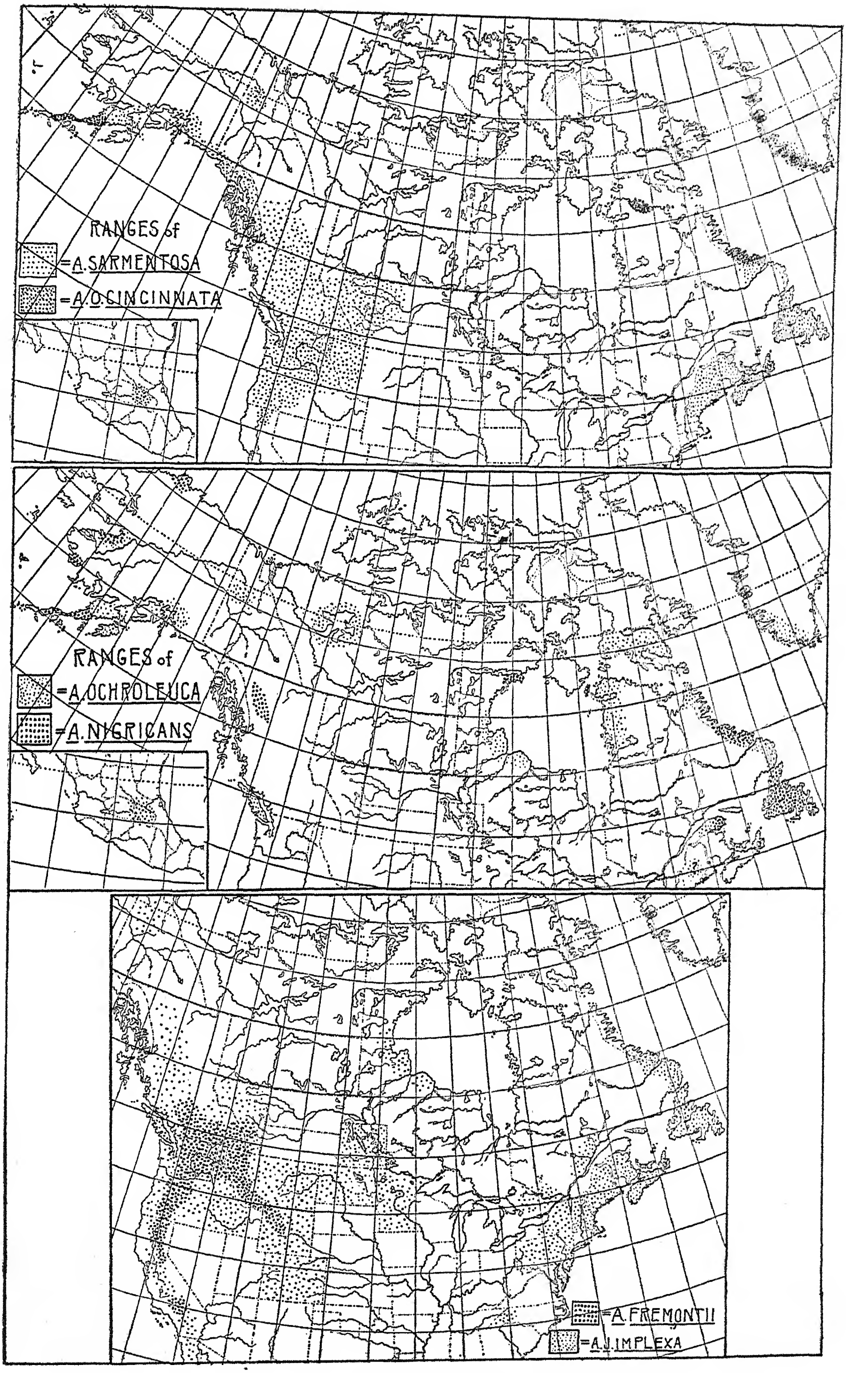
SUBSTRATA: On trees.

GEOGRAPHICAL DISTRIBUTION: Shores and islands of the strait of Georgia, British Columbia and Puget sound, Washington; also atypical examples examined from Silverton, Oregon, and Goldendale, Washington.

OBSERVATIONS: This plant is poorly represented in our area. Though Taylor's original description included the apothecia, the type is sterile, and according to Hue the apothecia are unknown. Mr. G. K. Merrill described our virescent examples as belonging to a new species, differentiating it from *virens* on the ground of its tortulous branches. As a tortulous condition is characteristic of a number of the pendulous *Alectorias,* as well as being true of the type of *virens,* our examples, if recognized as distinct, must be referred to this species of Taylor with which they are closely comparable. Seeming intergrades, however, occur with *jubata* through *implexa,* and only more material not now available can decide its true relationship. I cannot help doubting in this light Müller's attributed affinity.

SPECIMENS EXAMINED

OREGON: Silverton, *A. S. Foster,* Apr. 5, 1910 (NH). WASHINGTON: Goldendale, *A. S. Foster,* Dec. 20, 1909 (940 SMC); Friday harbor, *B. Fink,* June 28, 1906 (5487 F; 1252, 1543 H).



MAPS SHOWING DISTRIBUTION

I have excluded from this genus *Oropogon Loxensis* (Fée) Th. Fr. as have recent authors on the ground of its distinctive spore differences. This monospecific genus will be treated in a later paper.

In concluding this study I have many persons to thank, not only for the loan of material, but for much assistance in the examination of literature. For the most part they have been those persons who have helped in the past in the preparation of my papers on the *Usneas* and *Evernias*, and without whose ready help the completion of these studies would have been impossible.

THOREAU MUSEUM NATURAL HISTORY,
CONCORD, MASSACHUSETTS.

EXPLANATION OF PLATE 41

1. *Cetraria californica* Tuck. Specimen in the U. S. National Herbarium. × ⅔.

2. *Cetraria californica sepincola* R. H. Howe, Jr., ex Tuck. Specimen in the U. S. National Herbarium. × ⅔.

3. *Alectoria osteina* Nyl. Specimen Taylor Herbarium, Boston Society Natural History, from Mexico. × ⅔.

4. *Alectoria bicolor* (Ehrh.) Nyl. Specimen No. 1861, Author's herbarium from Yukon. × ⅔.

5. *Cetraria californica* Tuck., reduced condition. Specimen in the U. S. National Herbarium. × ⅔.

EXPLANATION OF PLATE 42

1. *Alectoria chalybeiformis* (L.) Gray. Specimen in the herbarium of the Boston Society Natural History. Slightly reduced.

2. *Alectoria divergens* (Ach.) Nyl. Specimen in the Taylor Herbarium, Boston Society Natural History. × ⅓.

3. *Alectoria Fremontii* Tuck. Specimen (cotype) in the Taylor Herbarium, Boston Society Natural History. × ½.

4. *Alectoria jubata implexa* (Hoffm.) Ach. Specimen in the herbarium of Dr. L. W. Riddle, Wellesley, Mass. × ⅓.

EXPLANATION OF PLATE 43

1. *Alectoria sarmentosa* (Ach.). Specimen in the herbarium of Wellesley College. × ½.

2. *Alectoria virens* Tayl. Type specimen in the Taylor Herbarium, Boston Society Natural History. × ½.

3. *Alectoria oregana* Nyl. ex Tuck. Specimen in the Sprague Herbarium, Boston Society Natural History. × ½.

4, 5. *Alectoria oregana* Nyl. ex Tuck. Specimens (cotypes) in the Sprague Herbarium. × ½.

EXPLANATION OF PLATE 44

1. *Alectoria ochroleuca cincinnati* (Fr.) Nyl. Specimen in the herbarium of the New York Botanical Garden. $\times$ 1.

2. *Alectoria nigricans* (Ach.) Nyl. from St. Michael's island, Alaska. Specimen in the herbarium of C. E. Cummings, Wellesley College. $\times \frac{2}{3}$.

3. *Alectoria ochroleuca* (Ehrh.) Nyl. from St. Michael's island, Alaska. Specimen in the herbarium of C. E. Cummings, Wellesley College, $\times \frac{2}{3}$.

4. *Alectoria ochroleuca* (Ehrh.) Nyl. showing apothecia. Specimen from Norway in the National Herbarium. $\times$ 1.

5. Apothecia of *Alectoria Fremontii* Tuck. much enlarged.

6. Apothecia of *Alectoria sarmentosa* (Ach.) much enlarged.

7. Apothecia of *Alectoria oregana* Nyl. ex Tuck. much enlarged.

EXPLANATION OF PLATE 45

1. Type of *Alectoria divergens* (Ach.) Nyl. in the Acharian Herbarium. $\times$ 1.

2. Type of *Alectoria sarmentosa* (Ach.) in the Acharian Herbarium. $\times$ 1.

3. Type of *Alectoria nigricans* (Ach.) Nyl. in the Acharian Herbarium. $\times$ 1.

4. Acharian plate of *Lichen sarmentosa*, evidently drawn from type specimen. $\times$ 1.

5. Dillenian plate of *Usnea jubata* on which Linnaeus based his species *Lichen jubatus*. $\times$ 1.

A GUM-INDUCING DIPLODIA OF PEACH AND ORANGE

H. S. Fawcett and O. F. Burger

A species of *Diplodia* has been isolated in pure cultures from both peach trees and orange trees in Florida, and by inoculation tests has been shown to produce copious gumming on healthy individuals of these hosts.

This species was first obtained from the interior of gumming peach branches on July 14, 1910; and the usual methods were employed to secure pure cultures free from possible bacteria or associated fungi. The same fungus was afterwards isolated from specimens of gumming peach branches from five different localities in five counties of Florida. The two most widely separated localities were West Tampa and Pensacola, about 350 miles apart. A fungus which appears identical with this was isolated from gumming orange branches on September 3, 1910, and it has since been isolated from diseased orange limbs and decaying orange fruits from ten different localities, in six counties.

In all, ten series of inoculations covering a period of five months have been made on peach and orange trees; five series by introducing pure cultures of the *Diplodia* isolated from the peach into peach trees; three series by introducing pure cultures, isolated from orange, into orange trees; and two series of cross inoculations by introducing the peach *Diplodia* into orange trees and the citrus *Diplodia* into peach trees. The peach trees used for these inoculations were about two years old, and the orange trees one to three years old. They were growing in pots in the greenhouse. In most of these inoculations the bark was cut through with a sharp scalpel, a bit of fungus mycelium inserted, and the inoculated portion wrapped in oiled paper and tied with raffia. A few inoculations were made without cutting the bark. Check trees, cut and wrapped in the same way, but not inoculated, were kept in every case.

Every peach tree on which the bark had been cut and a bit of fungus inserted, began to gum in from four to seven days, the tissue near the point of inoculation gradually dying. In no case were any of the trees killed; but in one instance the cambium on one side of the stalk was killed to a distance of seven and one half inches from the inoculated point, and pycnidia of the *Diplodia* were produced along the deadened area sixteen days after the inoculation. In most cases the gum oozed out in tough, irregular masses one half to three fourths of an inch across, and remained attached, not only at the point of inoculation, but at other points on the bark. In one instance a mass of gum was formed six inches from the point of inoculation. One inoculation was made by slightly scraping the outer bark and placing on it a bit of mycelium. In this case gumming also occurred. Other inoculations were made by placing bits of the mycelium in contact with uninjured bark of different ages. Where the twigs were tender and green, gum was induced, but where branches were older no infection took place.

In no case did the check trees exude any gum, and the cuts which had been made gradually healed up in the normal way.

Orange trees were also inoculated, in the same manner as described for the peach trees, with cultures isolated from citrus trees. In nearly every case a flow of gum was produced, which was more watery than that of the peach, but in time hardened into large tear-like drops below the point of inoculation.

The orange trees kept as checks, which had been cut and wrapped in the same way as the inoculated trees, failed in every instance to produce gum, and the cuts gradually healed up in the regular way.

Cross inoculations were finally made in which the peach *Diplodia* was introduced into cuts in orange trees, and the citrus *Diplodia* was introduced into cuts in the bark of peach trees. The result was that gumming was produced in every case, in the same way as previously described.

Cultures of this fungus were again isolated from these inoculated peach and orange trees, and these cultures showed the same features of growth as those from which the inoculation had been made. As far as known to the writers, this is the first time that

any of the species of *Diplodia* have been shown to produce gumming in trees.

The same fungus was also isolated a number of times from rotting fruits of orange and of grapefruit. It was shown by further inoculation experiments that the fungus was able to cause softening and decay of various fruits. Oranges, lemons and apples after being inoculated with a bit of the mycelium, softened in from one to two weeks. It was only necessary to place the fungus on the stalk end of picked lemons and oranges to produce decay, after which the fungus could be isolated from the interior of the fruits.

In looking up literature on *Diplodia,* our attention was called to recent inoculation experiments by I. B. Pole Evans in the Transvaal, in which he had shown that a *Diplodia* was the cause of decay in lemons and other citrus fruits. An examination of the description of this fungus by I. B. P. Evans, in Science Bull. No. 4 of the Transvaal Department of Agriculture, appears to show that the Florida *Diplodia* on peach and citrus may be the same as *Diplodia natalensis* Evans. Specimens were examined by Mrs. Flora W. Patterson, mycologist at the U. S. Department of Agriculture, who reported that the microscopic morphology of the citrus fungus agreed quite well with the descriptions of Evans' species. Further study and a comparison of cultures of the two fungi will, however, be necessary to determine this point. A more detailed description of these inoculation experiments, and of the cultural characters of this gum-inducing and fruit-rotting fungus will be published later.

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A NEW SPECIES OF ALTERNARIA

L. L. Harter

Forsythia suspensa Thunb. is not a native of the United States, but is an introduction from China. It is grown as an ornamental shrub in this country and is fairly common in the District of Columbia on government ground and in private gardens. The different species of *Forsythia* are very free from fungous diseases, *F. suspensa* being especially so.

On November 11, 1910, the writer collected the fungus described below on the leaves of many plants which were growing in a dense cluster on the Mall near Thirteenth Street and just south of the green houses belonging to the United States Department of Agriculture. Hundreds of plants were grown in the cluster where the specimens were collected and probably seventy-five per cent. of the leaves were affected. From the general character of its growth the fungus is strongly suspected as being a parasite.

The spots caused by the fungus occur indiscriminately over the surface of the leaf. They are subcircular in outline, gray to grayish-brown in color, and surrounded by dark-brown or dead areas. One or more concentric rings are formed about the grayish spots, within which are collected minute black tufts irregularly distributed and visible to the naked eye. The concentric rings, characteristic of some species of this genus, occur only on the upper surface, while the tufts are present on both the upper and lower surfaces.

Alternaria Forsythiae sp. nov.

Caespitulis amphigenis, numerosis, plerumque epiphyllis; maculis subcircularibus, griseis vel griseolo-brunneis, concentrice zonatis 2–10 mm. diameter; hyphis fasciculatis, erectis, septatis, tortuosis, olivaceis; conidiis, acrogenis, clavatis, olivaceo-brunneis, catenulatis, muriformibus, ad septa constrictis 18–60 × 10–16.5 μ, isthmis 5–15 × 3.5 μ.

HABITAT: Living leaves of *Forsythia suspensa* Thunb.

TYPE LOCALITY: On the Mall of the government grounds, District of Columbia.

Type specimens are deposited in the pathological herbarium, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

NOTES ON SOME SPECIES OF GYMNOSPORANGIUM IN COLORADO

Ellsworth Bethel

[With Plate 48, Containing 2 Figures]

Colorado possesses an unusually large number of interesting cedar rusts. Nine distinct species are recognized (ten with the new species described below), which is about one third the number of the telial forms known to occur in the United States. These have been brought to notice through the careful investigations of Dr. Arthur and Prof. Kern, who have visited the state twice in search of rusts, supplemented by the work of the writer in making collections and field observations for the purpose of connecting them with their roestelia stages. Of the nine species, five have been connected with their roestelia stage through the culture work of Arthur and Kern, and, with telial material of *Gymnosporangium juniperinum* (L.) Mart. collected this spring, it is hoped that its connection with *Roestelia fimbriatum* Arthur will be established, since abundant field observations point to this relationship.

There is only one known unconnected *Roestelia,* that of the pear and quince, which is probably not related to any of the three unattached species, namely, *G. durum* Kern, *G. speciosum* Peck, and *G. multiporum* Kern, unless it be *G. durum.* For the purpose of getting culture material of these three unattached species, and especially to gather information regarding the pear and quince rust, the writer made a short visit to the southwestern part of the state during his spring vacation last month. Nothing could be learned of the pear rust, as the trees had been cut down some years ago on account of the disease. Good telial collections were made of *G. durum* and *G. inconspicuum* Kern (already connected by culture with *Roestelia Harknessianoides* Kern).

It was a great disappointment not to get culture material of *Gymnosporangium speciosum,* as noted below in discussion of *Aecidium gracilens.* However, this arduous trip of five hundred miles was amply rewarded by the discovery of an unique species, apparently undescribed, which causes the dense, globose "witches' brooms" (2 in. to 2 ft. in diameter) on the Utah cedar (*Juniperus utahensis*). The cause of these conspicuous "brooms" has been attributed to some one of the numerous insects, such as coccids, aphids, etc., which inhabit them. The writer, however, has for some years entertained the belief that they were due to a species of *Gymnosporangium* but has been unable to verify this suspicion until this spring on account of not being able to visit the region at the proper season to make collections. An examination of the "brooms" at this time revealed the fact that a small *Gymnosporangium,* somewhat resembling *G. Nelsoni,* was the cause of the fasciation, and that the presence of the insects is merely incidental, as they find convenient shelter among the compact branchlets. This interesting species, conspicuous on account of the fasciation it produces, is characterized as follows:

Gymnosporangium Kernianum sp. nov.

Telia arising between the scale-like leaves, causing a fasciation of the young shoots and forming dense, globose "witches' brooms" 5–60 cm. in diameter; sori scattered, solitary, hemispheric, 0.5–0.8 mm. across, rather compact, dark reddish-brown; spores usually two-celled, narrowly ellipsoid, large, 21–26 $\times$ 55–74 μ, only slightly or not at all constricted at the septum; wall thin, about 1 μ, yellowish, smooth; pedicel hyaline, cylindric, very long; pores usually two, near the septum.

On *Juniperus* (*Sabina*) *utahensis* (Engelm.) Lemm., Paonia, Colorado (*type*), March 28, 1911; Glenwood Springs, Colorado, March 27, 1911, *E. Bethel.* Type deposited at the New York Botanical Garden.

This species produces a very compact, perfectly spherical fasciation (see Fig. 2), the numerous branchlets becoming weaker than normal, and the scales smaller, thus differing from the fasciation of *G. Nelsoni,* in which the scales of the affected

branchlets usually become more subulate, resembling those of the younger growth (see Fig. 3). In having small and inconspicuous sori, it resembles *G. Nelsoni, G. multiporum* and *G. inconspicuum.* The telia of the new species in germination become obliquely conic; of *G. Nelsoni* Arth., hemispheric; and of *G. multiporum* Kern, ellipsoid-hemispheric. The sori of *G. inconspicuum* appear as a faint brownish line encircling the scales, until diliquescence, when they spread out as a thin, yellowish film. In spore characters, also, the new species differs from the above named species (see Fig. 1); *G. multiporum* has

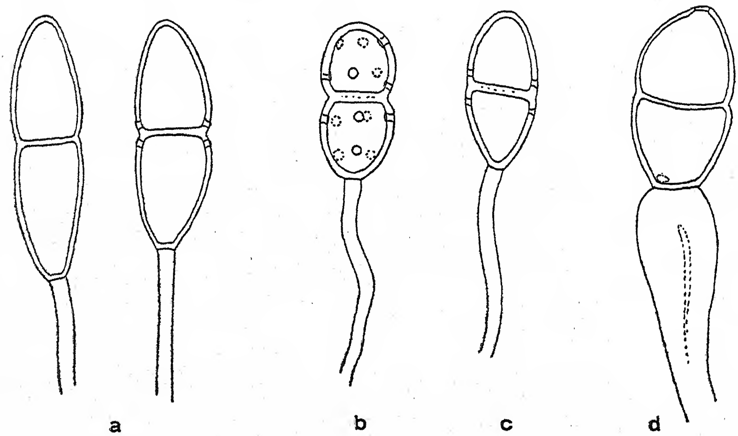


FIG. 1. Teliospores of (*a*) *Gymnosporangium Kernianum,* (*b*) *G. multiporum,* (*c*) *G. Nelsoni,* (*d*) *G. inconspicuum,* drawn to the same scale, approximately × 475.

four scattered germ-pores, *G. inconspicuum,* one in each cell, apical in the upper and near the pedicel in the lower; *G. Nelsoni* has one or two germ-pores in each cell near the septum as in the new species, but the spores are much smaller, 18–26 × 39–52 μ, and broadly ellipsoid, with pedicel inflated at juncture with spore.

There are no clues as to its roestelial connection, though it probably belongs to *Amelanchier* and *Peraphyllum,* which form extensive chapparal around the infected trees.

It is with especial pleasure that this species is dedicated to Prof. Frank D. Kern, who, through extensive observations in the field and painstaking culture work, has rendered invaluable

service in adding to our knowledge of the Rocky Mountain forms, which had hitherto been much confused and largely unknown.

NOTE ON AECIDIUM GRACILENS PECK

Specimens of this aecium on *Philadelphus occidentalis* were collected by Mr. G. E. Osterhout at Glenwood Springs, Colo., in August, 1906. It was at that time thought by the writer to be a *Roestelia* and was placed in his herbarium for future study. The specimen was forgotten and overlooked until recently when working over the roestelial forms attention was again attracted to it. An investigation of the locality where the collection was made revealed the presence of *Gymnosporangium speciosum* Peck on *Juniperus utahensis* in close proximity. This gave a suspicion that the two might be related and that *A. gracilens* Peck might prove to be a true *Roestelia*. Through the kindness of Dr. J. C. Arthur, the writer was permitted to examine authentic specimens of this form and the Glenwood specimens were found to be the same. This species, while referred to *Aecidium* by Peck, possesses many characteristics of a true *Roestelia*, among them being the elongated, membranous peridium, peridial cells loosely joined together with characteristic sculpturings on the inner and side walls, and aeciospores with evident germ-pores.

An examination was then made of the distribution of the two species, and the range, central Colorado to N. Mexico and Arizona, was found to be the same. The few collections of this rare aecidium, so far as can be learned, have been taken where *G. speciosum* abounds; likewise *Philadelphus* is common in most localities where it has been found.

In the cliff-dweller country (Mesa Verde National Park) in southwestern Colorado, near Mancos, the writer on collecting trips in 1897 and 1900 found *G. speciosum* epidemic on *Juniperus utahensis*. *Philadelphus* was very abundant but no search was made at that time for any *Roestelia* on it.

In order that the attention of collectors may be directed towards securing additional collections and data, the following

localities known to the writer for the *Aecidium* and *Gymnosporangium* are given:

A. GRACILENS Peck: on *Philadelphus microphyllus*, "Colorado," 1879, *Brandegee* (*type*); on *Philadelphus* sp., El Capitan Mts., Lincoln Co., New Mex., July, 1906, *Earle;* on *Philadelphus occidentalis,* Glenwood Springs, Colo., Aug., 1906, *Osterhout.*

GYMNOSPORANGIUM SPECIOSUM Peck: on *Juniperus* sp., "Colorado," *Brandegee,* (*type*); on *Juniperus utahensis,* Mancos, Colo., June, 1897, *Bethel;* Glenwood Springs, Colo., May 1, 1907, *Arthur & Kern;* June, 1907, *Bethel;* Paonia, Colorado, August, 1909, *Bethel;* on *Juniperus monosperma,* Cañon City, Colo., Walsenburg, Colo., Trinidad, Colo.,—all in June, 1909, *Bethel.*

The relationship of *A. gracilens* to *G. speciosum* is merely inferential and is based on field observations, distribution, and the apparent roestelial characters of the *Aecidium.* Further, the fact that sowings of *G. speciosum* have been tried unsuccessfully on *Amelanchier, Crataegus,* and *Sorbus* supports the inference that it may have its roestelial stage outside of the Malaceae. This would be a very interesting connection, if established, since the only known case of a *Roestelia* outside of the ligneous Malaceae is that of *G. exterum* Arth., which occurs on *Gillenia stipulacea,* an herbaceous annual of the Rosaceae, while *Philadelphus* belongs to the Hydrangiaceae. *G. speciosum* occurs in woody tissue of old branches, emerging through the bark in long longitudinal, sinuous masses of a reddish or orange color, which ultimately fade to a white color. It causes large hypertrophies, sometimes six to ten inches in diameter, superficially resembling those of *Peridermium Harknessii* Moore, on species of pine.

DENVER, COLORADO.

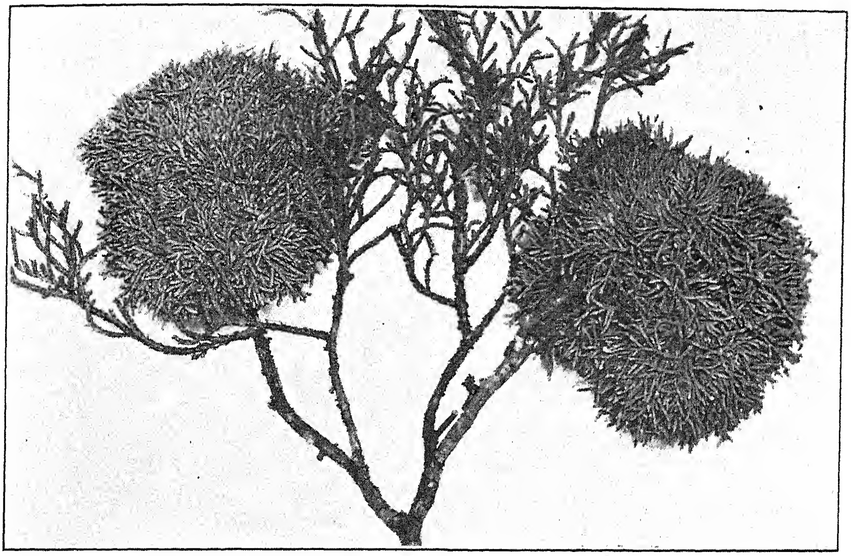


Fig. 2. Gymnosporangium Kernianum on Juniperus utahensis

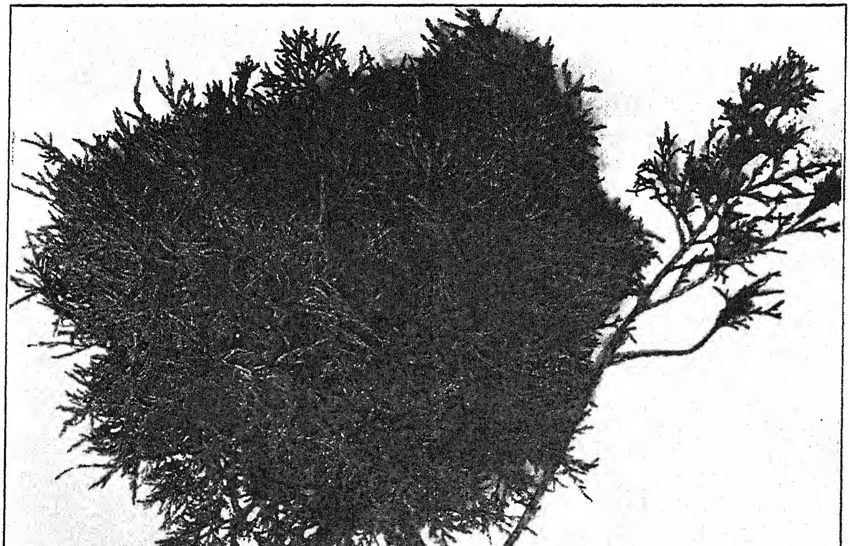


Fig. 3. Gymnosporangium Nelsoni on Juniperus scopulorum

NEWS AND NOTES

The Charleston Museum has secured the assistance of Mr. E. R. Memminger in a revision of the Henry W. Ravenel herbarium and the preparation of a catalogue of the fungi of South Carolina.

Mr. W. H. Rankin, Fellow in Plant Pathology at Cornell University, made his headquarters at the Garden during most of May, while beginning an investigation of the chestnut canker with special reference to its control in New York state.

Under the title "Fungi Lyndonvillenses novi vel minus cogniti," Dr. Chas. E. Fairman (Ann. Myc. 9: 147–152) describes the following new species of fungi: *Phoma cercidicola, Phoma Halesiae, Phoma regina, Cladosporium Vincae, Volutella Vincae, Mollisia lanaria, Septoria lanaria,* and *Phialea phaeconia.* Also *Ophiobolus vulgaris, Gnaphalii* Sacc. & Br. is raised to specific rank and the new variety, *Ophiobolus Gnaphalii lanaria* is described.

We learn from *Science* that, on April 11, Governor Tener sent a special message to the Pennsylvania legislature, recommending immediate legislation for control of the chestnut canker. A bill has since been passed providing for a commission to undertake this work, and carrying a total appropriation of $275,000. So far it is only the eastern and southeastern counties of Pennsylvania that are completely infected with this disease, and it is hoped, by the elimination of spot infections in advance of the line of general occurrence of the disease, to restrict its spread to this area. The great chestnut forests of the state which, according to the state department of forestry, have a total valuation of approximately $50,000,000, are still essentially untouched by the disease, and the great object of the proposed legislation is to save these. Experiments made by the national department of agriculture appear to have demonstrated practical methods of quar-

antine against this disease; and Pennsylvania is the first state to undertake these methods on a large scale.

"The Lichens of Minnesota," by Professor B. Fink of Miami University, Oxford, Ohio, is based on extensive field work under the auspices of the Geological and Natural History Survey of Minnesota extending over a period from 1896 to 1902. In the preparation of the text since the latter date, the libraries of the United States Department of Agriculture at Washington, the Lloyd Botanical Library at Cincinnati, and the library of the Missouri Botanical Garden have been consulted.

In this work the treatment of generic names is in accordance with present usage and synonyms are omitted except the citation of the first binomial used where a species has been transferred from the genus in which it was originally described.

The preliminary chapter consists of a concise treatment of the origin and nature of lichens, their morphology, reproduction, and economic bearing. While it is noted that some botanists hold that the lichens should be distributed among the fungi, no attempt has been made to do so in this paper.

The body of the work contains keys to the genera and descriptions of the families, genera and species. More than three hundred species are described and many of them beautifully illustrated with half-tone cuts. While the title of the work would indicate that it is restricted in its scope, the lichens of Minnesota are typical of many other localities and the work will be found to be of great value to students interested in this group of plants. The entire work comprises 269 + xvii pages of text and 51 plates, besides a number of text figures.—*F. J. Seaver.*

The Genus Fimetaria.—With reference to the substitution of *Fimetaria* for the generic name of those fungi commonly included in the genus *Sordaria,* the following criticism appears in Ann. Myc. 9: 192: "Aus welchem Grunde der allbekannte Gattungsname *Sordaria* durch den neuen Namen *Fimetaria* ersetzt wirt ist nicht ersichtlich. Jedenfalls ist diese Umnennung nicht zu billigen, wie auch in der im Jahre 1901 erschienenen monographischen

Bearbeitung der nordamerikanischen Sordariaceen seitens Griffiths der Gattungsname *Sordaria* beibehalten worden ist."

The new generic name was published in *North American Flora* 3: 65. Since no opportunity is given in that work for extended notes and in view of the above criticism, it is thought well to give our reasons for this substitution of names.

In the American Code of Botanical Nomenclature, sec. IV, canon 15 (c), we find the following rule relative to the fixing of the type of a genus. "The application to a genus of a former specific name of one of the included species designates the type." As an illustration of the application of the above rule we read the following: "*Sordaria* Ces. & DeN. Comm. Soc. Critt. Ital. 1: 225 (1863), is typified by *Sphaeria Sordaria* Fr., one of its twelve species." *Sphaeria Sordaria* is, according to recent authorities, a *Rosellinia*, in the sense that *Rosellinia* is now used. The name *Sordaria* would then become a synonym of *Rosellinia* as now used, and the group of species to which the name *Sordaria* is commonly applied would be left without a name and since there is no other name in literature which could be taken up for the genus, the only alternative is the substitution of a new name. In brief, then, this substitution of *Fimetaria* as the generic name of those species commonly known by the old name *Sordaria* was made in order to make the work of *North American Flora* conform to the requirements of the rules of the American Code of Botanical Nomenclature.—*F. J. Seaver.*

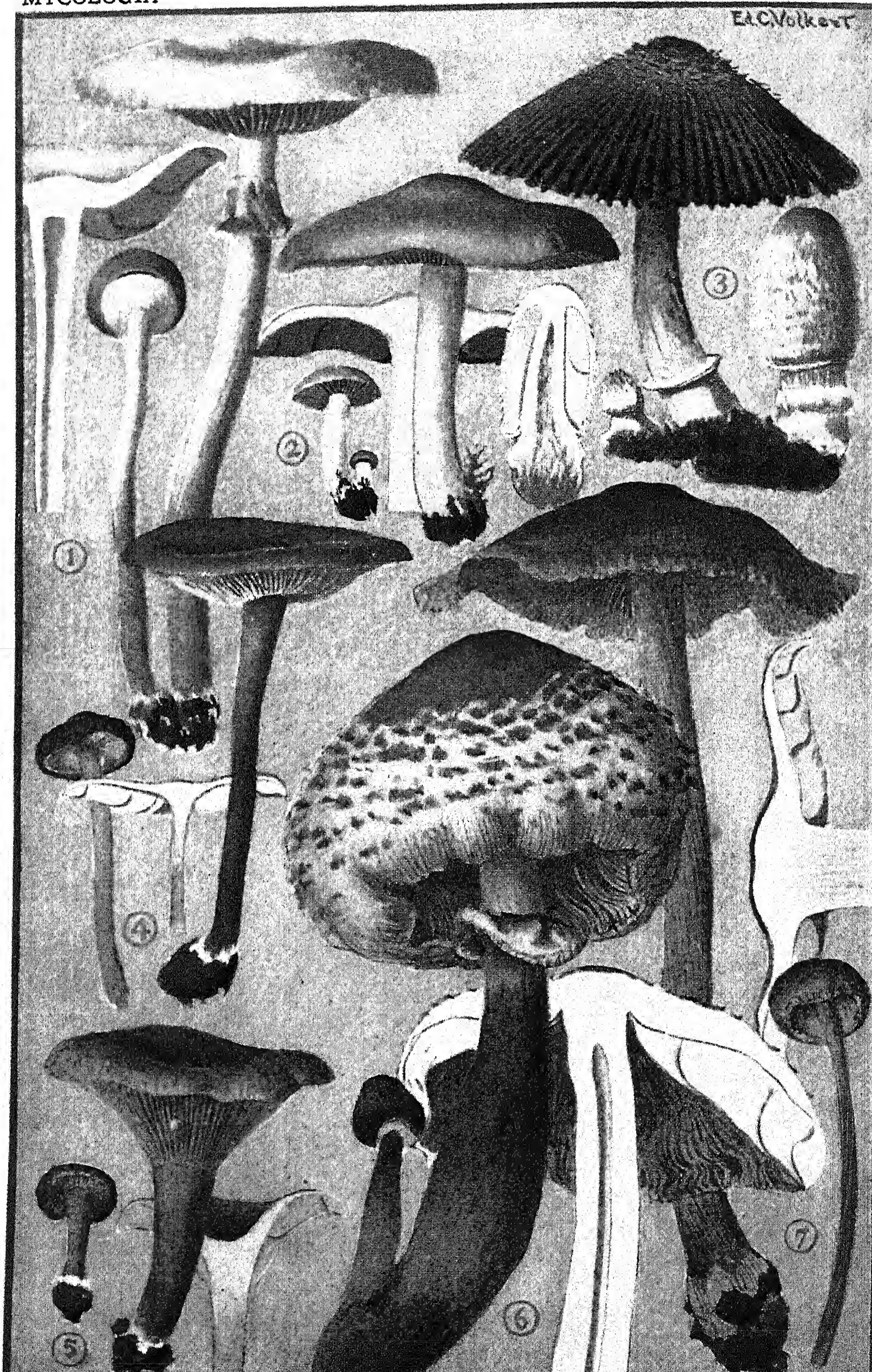
McAlpine's "Smuts of Australia."—From McAlpine's previous work, especially his "Rusts of Australia," one would naturally expect a good piece of investigation in his "Smuts of Australia," and an examination of this, his latest work, entirely confirms this expectation. Probably no other book brings together so much general information regarding this important group of fungi. The author treats the subject from a threefold point of view. First, he gives in detail information regarding the general nature of smuts, character of the mycelium, spores, germination, infection of hosts, immunity, etc. Second, he takes up certain economic smuts, as the grain and grass species, and treats them very

fully as to their life history, prevention, etc. Finally, he considers them from the systematic point of view, and classifies and describes the sixty-eight species, under ten genera, that have been reported for Australia. An extended bibliography of smuts in general, together with host, species and general indices, completes the work.

Regarding the origin of the smuts, after discussing the opinions of others, he says: "My own idea is that the Ustilagineae may be simply regarded as forms which have a distinct alternation of a saprophytic with a parasitic stage, and with sexuality grafted onto this, they originated the Uredineae. It is considered that the promycelium bearing the conidia is a saprophyte, because it generally grows freely in a nutritive solution."

Regarding his characterization of genera, as exemplified largely by the species included, there is room for a decided difference of opinion. Personally, the writer would not make *Cintractia* embrace such a variety of species as he has done, since if we include all species that have a more or less radial development of spores, we would hardly know where to stop. We also believe that the false membrane of sterile fungous cells enclosing the spore mass, as indicated by the genus *Sphacelotheca*, is of generic importance, a genus, however, that he fails to recognize in his classification. *Sorosporium Reilianum* under its new generic position is apparently no more happily placed than it was in its previous experience under *Ustilago*, *Cintractia*, or *Sphacelotheca*, since the spore-balls at best are very vague affairs. However, it is an easy matter to criticise the opinions of others when they differ from our own. If we were all to agree on generic and specific characters, the "natural" system of classification would have been here long ago, which is merely another way of stating that it never will come.

In the matter of illustration, this monograph is well supplied with excellent photomicrographs of the spores.—*G. P. Clinton.*



ILLUSTRATIONS OF FUNGI

MYCOLOGIA

Vol. III JULY, 1911 No. 4

ILLUSTRATIONS OF FUNGI—IX

William A. Murrill

The specimens here illustrated were collected and drawn during the summer of 1910. They are all represented natural size, and, being larger, will be found less difficult to identify than the small species figured in the May number of this journal.

In the printing of the accompanying plate, the red color, as frequently happens, came out too strongly, giving a purple tint to some of the figures. In figure 2, the pileus and gills should be fulvous; in figure 7, the pileus should be dark-fulvous with a chestnut tint.

Pholiota candicans (Bull.) Schröt.

Pholiota praecox (Pers.) Quél.

Early Pholiota

Plate 49. Figure 1. × 1

Pileus fleshy, convex to plane, at times umbonate, solitary or gregarious, 3–7 cm. broad; surface smooth or pitted, glabrous, moist, whitish, cream-colored or isabelline, the center often darker; lamellae adnexed, crowded, white, becoming fulvous; spores ellipsoid, smooth, ferruginous, 7–8 × 5 μ; stipe subconcolorous, equal, glabrous, 4–8 cm. long, 3–5 mm. thick; veil large, white, forming a conspicuous and permanent annulus near the apex of the stipe.

This is one of our best edible species, and it occurs quite abundantly during spring and summer in grassy and open places throughout temperate regions.

[Mycologia for May, 1911 (3: 97–164), was issued June 3, 1911.]

A very interesting sterile form of this species has appeared in abundance, both last year and this year, beneath a large white oak on the grounds of the New York Botanical Garden, a few fertile sporophores being present in each case and being similar in all respects to the sterile ones except as regards spore formation. The lamellae of the sterile plants remain pure-white and exceedingly thin; microscopic sections show the basidia undeveloped and devoid of sterigmata, the very few inflated cystidia being similar in form and abundance in both fertile and sterile sporophores. The sterility is absolute and without apparent cause.

Hebeloma praecox sp. nov.

EARLY HEBELOMA

PLATE 49. FIGURE 2. $\times 1$

Pileus convex to expanded, slightly umbonate, gregarious, 4–5 cm. broad; surface dry, glabrous, opaque, smooth, ochraceous-isabelline; margin incurved, entire or undulate, showing no trace of a veil; context white, sweet, odor pleasant; lamellae sinuate, arcuate, close, many times inserted, pallid when young, fulvous at maturity; spores ovoid, smooth, pale-ochraceous, not conspicuously nucleate, $5–6 \times 3–4\,\mu$; stipe fleshy, brittle, subequal, stuffed to hollow, finely scabrous, sometimes rough, cremeous, 3–4 cm. long, 5–8 mm. thick.

Type collected among mosses on a shady bank in the New York Botanical Garden, June 20, 1910, by W. A. Murrill. Also collected again in the same spot, June 8, 1911. This is the first species of *Hebeloma* to appear in this locality. Although not at all viscid when found on either occasion, it might well become slightly so in wet weather. The remnants of the partial veil are left clinging to the stipe as the expansion of the pileus progresses, leaving none on the margin.

Coprinus sterquilinus (Fries) Quél.

LARGE-SPORED INKCAP

PLATE 49. FIGURE 3. $\times 1$

Pileus ovoid to expanded, cespitose, 3–7 cm. broad; surface white and villose in young plants, becoming radiate-sulcate and blackish with age, the disk at all stages being brownish and squar-

rose-squamose; lamellae free, crowded, ventricose, white to black; spores very large, ellipsoid, regular, smooth, black, $18 \times 12 \mu$ in specimens found, reported slightly larger by most authors; stipe attenuate upward, fibrillose, white, blackening when handled, subbulbous at the base, 5–8 cm. high, 4–8 mm. thick; veil small, white, cottony, remaining near the base of the stipe as a small annulus.

This interesting species was described by Fries in 1821 from specimens collected on cow dung in autumn. My own plants, collected on a manure heap in the grounds of the New York Botanical Garden, June 22, 1910, were compared with those at Upsala and found to agree perfectly. Specimens found by Dr. Peck on the ground in an open field near Ticonderoga in August were described by him in 1879 as *Coprinus macrosporus*. Bolton's *A. oblectus* is probably the same thing, but it is hard to determine this with certainty. The species seems to be rare and not generally well known, either in this country or in Europe. Its edible qualities have probably not been tested, but some of our best economic species, figured in MYCOLOGIA for March, 1909, belong to this genus.

Melanoleuca melaleuca (Pers.) Pat.

Tricholoma melaleucum (Pers.) Quél.

BLACK AND WHITE MUSHROOM

PLATE 49. FIGURE 4. $\times 1$

Pileus thin, convex to plane, depressed around the small umbo, solitary, 3–6 cm. broad; surface glabrous, fuliginous to fawn-colored, margin incurved when young; context thin, sweet, edible, inodorous; lamellae very white, ventricose, emarginate, crowded; spores ovoid-ellipsoid, finely echinulate, hyaline, uninucleate, 7–9 $\times$ 5–6 μ; stipe elastic, variable in color and size, subglabrous, slender, often enlarged above or below, 4–8 cm. long.

This well-known and exceedingly variable European species, occurring in open or slightly shaded grassy places, seems rare in America, and the form found about New York City appears so different from the normal European type as to be scarcely recognizable. To add further to the difficulty, this species is probably as much a *Collybia* as a *Tricholoma,* and *Collybia stridula* Fries seems hardly distinct from it. Dr. Peck has specimens from North Elba labeled *Tricholoma microcephalum* Karsten. His *T.*

melaleucum thujinum, from Warren Co., agrees best with our New York City form. *Tricholoma subcinereum* Peck is nearly allied, but is certainly distinct, having different spore characters.

Lactaria subdulcis (Pers.) Fries

SWEETISH LACTARIA

PLATE 49. FIGURE 5. × 1

Pileus fleshy, thin, convex, papillate, becoming depressed to infundibuliform, 1–5.5 cm. broad; surface fulvous, isabelline, or reddish-fulvous, not fading, azonate, dry, glabrous, smooth; margin involute, then spreading, sometimes flexuous: context firm, fragile, whitish or tinted with isabelline or fulvous, odorless, edible; latex white, unchanging, mild or slowly acrid to bitterish; lamellae whitish or tinted with isabelline, becoming pruinose, sometimes forking, close, adnate, or decurrent by a tooth, up to 3 mm. broad; stipe of the same color as the pileus or paler, nearly equal or tapering upwards, glabrous, or sometimes slightly pubescent at the base, dry, stuffed, becoming hollow, 2–7 cm. long; 2–6 mm. thick: spores white, globular to broadly ellipsoid, echinulate, $7 \times 8\,\mu$.

This edible species occurs on the ground in or near woods throughout the eastern United States and Europe. The above description is taken from Miss Burlingham's monograph of the genus *Lactaria,* published in volume 9, part 3, of NORTH AMERICAN FLORA.

Lepiota americana Peck

AMERICAN LEPIOTA. BLUSHING LEPIOTA

PLATE 49. FIGURE 6. × 1

Pileus ovoid to convex and at length expanded, umbonate, 5–15 cm. broad; surface white, umbo and scales reddish-brown, the entire plant becoming reddish-brown when wounded or on drying; lamellae white, free, close; spores subellipsoid, smooth, hyaline, uninucleate, $7.5\text{–}10 \times 5\text{–}7\,\mu$; stipe thickened below, white, hollow, 7–12 cm. long; veil white, forming an apical annulus.

A conspicuous and easily recognized edible species of wide distribution in America, occurring in groups or clusters on rich lawns or about old stumps, sawdust piles, or compost heaps from midsummer to autumn. *Lepiota Morgani,* a poisonous species resembling it in shape, has green spores, causing the gills to assume a green color as they mature.

Collybidium luxurians (Peck) Murrill

LUXURIANT COLLYBIDIUM

PLATE 49. FIGURE 7. × 1

Pileus convex to expanded, umbonate, cespitose, 5–8 cm. broad; surface dry, faintly radiate-striate but not fibrillose, fulvous, with bay umbo, irregular with undulate margin; context somewhat tough but easily torn, odor pleasant, taste sweetish; lamellae sinuate, arcuate, rather close, narrow, crenulate, pallid, becoming discolored; spores oblong-ellipsoid, smooth, hyaline, $7–8 \times 3–4\,\mu$; stipe twisted, curved, slightly enlarged below, hollow, cartilaginous, pruinose, pallid above, tinged with fulvous below, 10–12 cm. long, 5–9 mm. thick.

This species was first described as a *Collybia* by Dr. Peck in 1897 from dried specimens sent him by Dr. Underwood, who collected them under brush heaps near Auburn, Alabama, in July, 1896. The accompanying illustration and description were drawn from plants collected by Mr. Volkert and myself in weeds at the edge of a sawdust pile near Bronx Park, June 20, 1910. They were found to agree with the type specimens at Albany in all important characters, but are only about one half as large.

MORPHOLOGY OF THE GENUS CEPHALOSPORIUM,

WITH DESCRIPTION OF A NEW SPECIES AND A VARIETY

R. E. Buchanan

(With Plates 50 and 51, Containing 9 Figures)

Certain species of the hyphomycetous genus *Cephalosporium* have been found to be of common occurrence in the humus-rich, prairie soils of Iowa. The morphology and relationships of this genus have not been well understood; it is therefore believed of interest to publish the results of a study of one of these species and a variety.

The genus *Cephalosporium* Corda is characterized by its well-developed hyaline mycelium and its slender, unbranched conidiophores which abstrict non-septate spores from the tip, these latter being pushed to one side by the later spores and all remaining as a head, stuck together by mucus. The genus *Hyalopus* Corda is differentiated from *Cephalosporium* by the abundant production of mucus, and the resultant globular refractive head produced. The distinction is made solely on the relative amount of mucus. *Allantospora* Wakk has been separated from *Hyalopus* on account of its allantoid, sometimes 1–2 septate, conidia. One species of *Allantospora* has been described, *A. radicicola* Wakk, upon the roots of *Saccharum officinarum*. Its obvious relationship to *Cephalosporium* has caused Saccardo (Sylloge **14**: 1043) to include it among the Amerosporae of the Mucedinaceae, while Clements in his "Genera of Fungi" has placed it under the Phragmosporae (Hyalophragmiae), doubtless because of the occurrence of septate spores. Lindau (Rabenhorst's Krypt. Flora **8**: 100–101) has expressed the opinion that the genera *Hyalopus* and *Cephalosporium* should be united. Under the heading of "*Hyalopus populi* Nypels" he says: "Bei kulten in feuchten Luft entsteht

das durch Schleim zusammengeballte kuglige Konidienköpfchen. Dagegen zeigen die Konidienträger in trockner Luft nur einzelne Konidien welcher locker zu Köpfchen zusammentreten. In letzteren Falle zeigt sich gegen *Cephalosporium* nicht der geringste Unterschied, so dass ich der Meinung sei möchte, *Hyalopus* ist nur ein unter feuchten Verhältnissen wachsendes *Cephalosporium*. Weitere Beobachtungen über die Bildung der Konidienköpfchen wären sehr erwünscht."

The species and variety of *Cephalosporium* here described were isolated from humus-rich soil on dextrose agar made up without intentional addition of combined nitrogen in any form. The colonies develop quickly on a variety of media, peptone agar and gelatin, mannite and dextrose N free agar, mannite dextrose and starch N free solutions, peptone solution, peptone and dextrose gelatin and solidified blood serum. The rapidity, type and luxuriance of growth exhibit some differences on the various media employed.

The mycelium is in all cases hyaline, at least when young, septate and much branched. The sterile hyphae are of indeterminate length. On dextrose agar plate cultures they grow from center to circumference of the Petri dish in the course of four days to a week at 20° C. The diameter of the hyphae varies from 5 to 25μ. The cell contents, at first homogeneous, become somewhat vacuolate and later hold a large number of oil drops. There is little evidence of negative chemotropism of the hyphae toward each other, as they cross and recross repeatedly. The hyphae penetrate the medium to a depth of half an inch in agar tubes. The organism grows well only in the presence of an abundance of oxygen. Aerial hyphae are not thrown off in abundance from the surface of a plate culture, but whenever the organism comes in contact with a foreign substance as the glass wall they are sent up in abundance. Some of these may reach a length of half an inch or more.

The conidiophores are developed abundantly on all hyphae that lie at the surface of the medium and upon the aerial hyphae when formed. A few develop even below the surface of the medium. They are slender, hyaline, and vary in length from a micron or two to twenty or thirty on some aerial hyphae and 10 to 50μ on a moist surface or in a moist atmosphere. They are usually non-

septate. They show little evidence of the negative hydrotropism so characteristic of many of our common molds, such as *Penicillium* and *Aspergillus*. Those developing from hyphae lying in contact with the medium are usually bound down by the water film and develop along its surface.

The spores are formed by the abstriction of the tip of the sporophore. Each is enveloped in mucus, the amount depending upon the moisture of the atmosphere in which it develops. In a dry atmosphere only sufficient is found to cause the spores to stick together in a head. In a moist atmosphere the globule of mucus swells until it completely envelops the spores, and careful observation will show them floating free in the liquid, which sometimes has three to four times the mass of the spores. That this is not merely water but mucus, is demonstrated by the preparation of a mount in alcohol, where the heads remain intact, because the mucus does not dissolve. When water is added, however, the spores are freed by the solution of the mucus and separate. Lindau's characterization of *Hyalopus* as a *Cephalosporium* grown in a moist atmosphere is justified. The heads vary in size from 10 to 35 μ and contain from two to numerous spores. The spores are ovoid to cylindric with rounded ends, usually with granules. When the sporophores are short, the spore masses are found upon the surface of the hyphae. The sporophore sometimes produces a head of spores, then, because of some undetermined stimulus, it resumes growth and produces a new head. This may occur several times and results in masses of spores at intervals along the sporophores. The spores developed on the moist surface of the medium are usually larger than those of the aerial conidiophores. When formed they frequently continue to enlarge after separation from the hyphae and become considerably elongated, even crescent-shaped, and falcate. When grown to several times their original length they become septate, from one to six or eight septa being formed. These spores then bud at one or more points and develop new conidia of a similar size and shape. In this manner large masses of sickle-shaped or allantoid, septate conidia are produced. They remain attached to each other by slender threads. Many of these spore masses in the older portion of the culture are distinctly visible to the naked eye. Rarely they reach a diameter of several millimeters. In some cases the spore mass has a

greenish tinge. In an atmosphere sufficiently moist some of the erect conidiophores are found to be capped by these long septate spores rather than by the more usual short, non-septate type. Every gradation in shape, size and septation may be observed in a single mount from some cultures. These latter allantoid, septate spores imbedded in mucus answer to the diagnosis of *Allantospora*. The spores of all types germinate readily. Germ tubes may issue from several of the cells of a septate spore. The spores borne on aerial conidiophores and forming heads of the *Cephalosporium* type are from 4–15μ in length and one half to one third as broad. Those that develop in a moist atmosphere and form heads of the *Hyalopus* type vary from 5 to 15μ and are one fourth to one half as broad as long. When developed on the surface of the medium in the presence of an excess of moisture, they either resemble the preceding or become allantoid or falcate, 20–30 $\times$ 3–5 μ.

From the foregoing description it seems evident that the genus *Hyalopus* should be merged with *Cephalosporium* as suggested by Lindau. It is also possible that *Allantospora* is but a growth form of *Cephalosporium*.

The variety *purpurascens* described below differs in no marked particular from the type except for the production of a purple pigment. This pigment production is somewhat inconstant, and is usually slow in making its appearance. In some cases the purple coloring matter is diffused into the dextrose agar in such quantities as to make it practically opaque and of a rich wine-red color. The pigment permeates the mycelium and is found in some of the spores.

It is possible that the following species has been observed and described in one of its growth forms, but none of the published diagnoses are sufficiently complete to allow of satisfactory identification.

It is a pleasure to acknowledge the author's indebtedness to Dr. L. H. Pammel for his many courtesies and valuable assistance.

Cephalosporium Pammelii sp. nov.

Hyphis sterilibus decumbentibus vel raris in aere crescentibus, longis, hyalinis, multis ramosis, vacuolatis denique protoplasmate cum oleis globulis repreto, articulatis, 5–15 μ crassis; chlamydo-

sporis 5–10 × 10–15 μ conidiophoris e mycelio lateraliter nascentibus, erectis vel decumbentibus, simplicibus vel raris ramosis, non vel raris septatis, 2–20 × 3–5 μ in aere sicco, 5–50 × 3–8 μ in aere humido, non hydrotropismis, summo capitulo globoso 10–35 μ diam.; conidiis in aere humido muco-glomeratis, in aere sicco separatis vel laxe cohaerentibus, ellipsoideis vel ovoideis et continuis, vel in aqua falcatis, allantoideis et 1–8 septatis, hyalinis, granulosis.

Hab. in dextrose agar pulvene terrae humosae infecta.

Var. *purpurascens*. Hyphis sterilibus primo hyalinis, albis, denique roseis vel purpureis; conidiis hyalini vel purpurascentibus, pigmento purpureo in alcohol et aqua soluto, in dextrose-agar et alteris mediis saccharis diffuso.

Hab. in dextrose agar pulvere terrae humosae infecta.

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EXPLANATION OF PLATE 50

Cephalosporium Pammelii Buchanan

1. Microphotograph of type. Mycelium, sporophores and spores on the surface of dextrose agar plate. Courtesy of Iowa Agricultural Experiment Station.

2. Microphotograph of type. Masses of falcate and allantoid, septate spores. Surface of dextrose agar plate. Courtesy of Iowa Agricultural Experiment Station.

EXPLANATION OF PLATE 51

Cephalosporium Pammelii and var. *purpurascens*

1. Aerial conidiophores developing in relatively dry air. *1a*. Medium moist air, therefore somewhat moist, mucus globule not evident. *1b*. var. *purpurascens*. Conidiophores in dry air after medium has dried. *1c*. var. *purpurascens*.

2. Conidiophores which have grown in length intermittently, with clusters of spores. *2a*. var. *purpurascens* developed in relatively dry air. *2b*. Type developed in moist air with mucus globules.

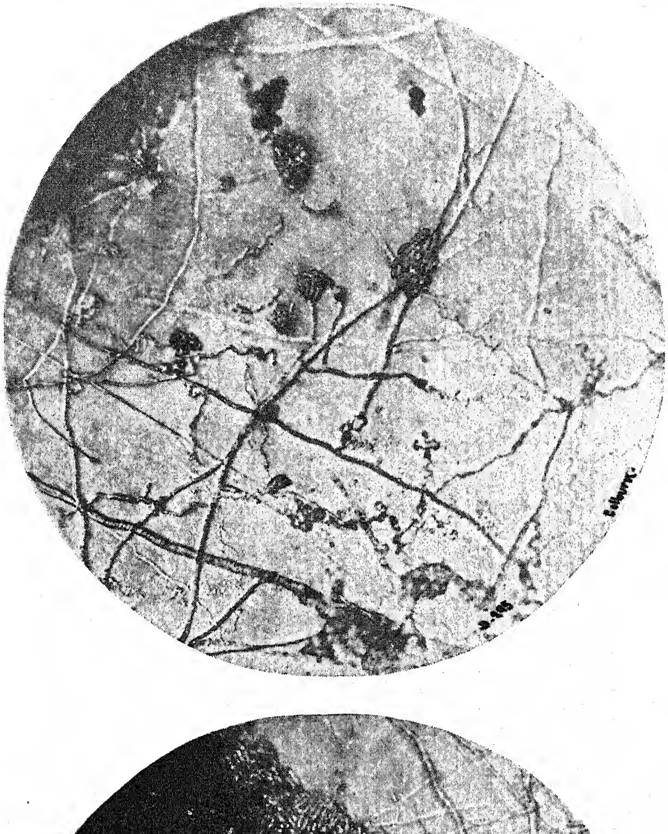
3. Aerial conidiophores of type, developed in moist air, showing the *Hyalopus* type of head.

4. Conidiophores of type produced in contact with the surface of moist agar. *4a, b, c, d*. Illustrating the variety of spore shapes and sizes, and the evident continued growth of the spore after abstraction.

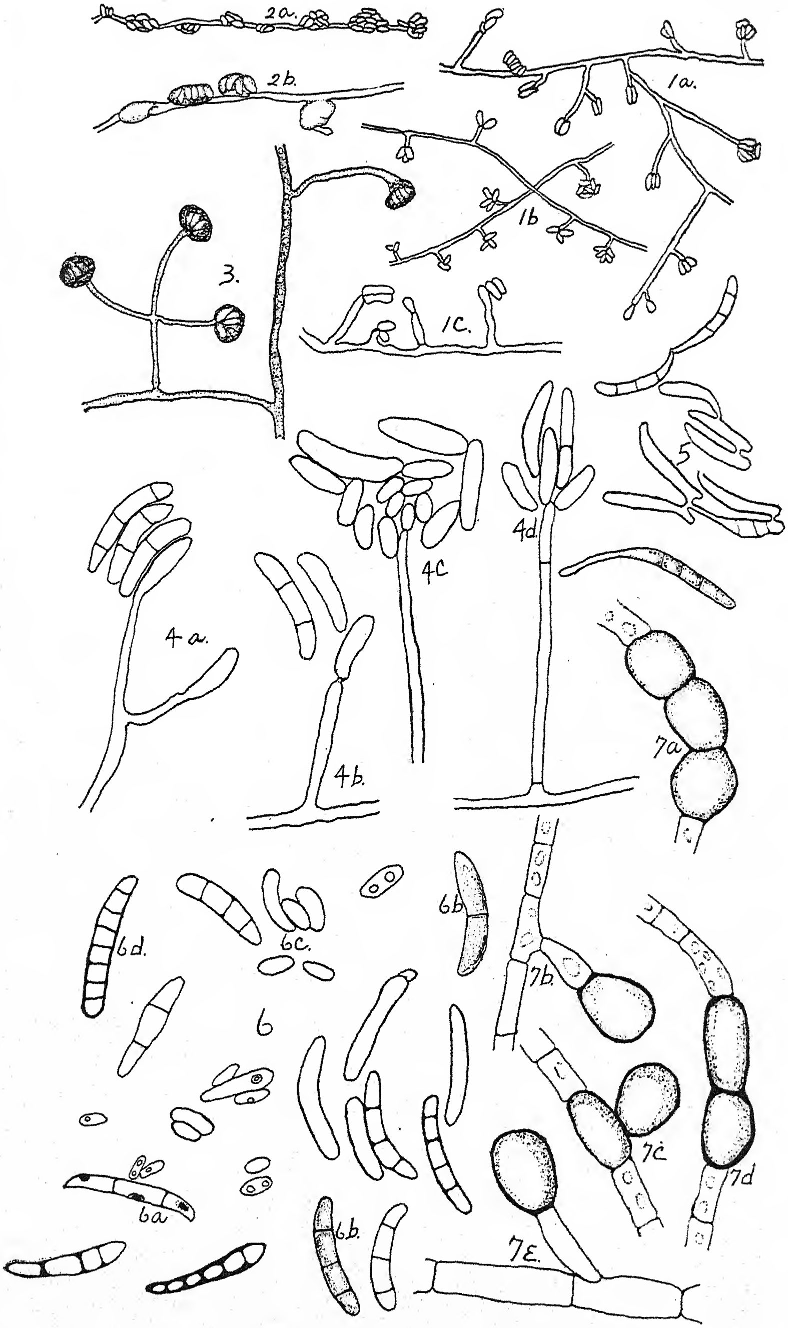
5. Falcate spores from a large spore mass, illustrating the method of budding and continued growth.

6. Spores from the surface of agar, showing the unicellular and multiseptate forms. *6a*. Septate spore from preparation stained with fuchsin to show the nuclei. *6b*. Septate spores of var. *purpurascens* with purple pigment.

7. Chlamydospores of the type, from dextrose N free agar. *7a, b, c, d, e*, showing development of spores, intercalary or terminal.



CEPHALOSPORIUM PAMMELII BUCHANAN



CEPHALOSPORIUM PAMMELII BUCHANAN

TOXICOLOGICAL EXPERIMENTS WITH SOME OF THE HIGHER FUNGI

Ernest D. Clark and John L. Kantor

INTRODUCTION

From the earliest times it has been observed that the consumption of certain species of mushrooms is followed by extremely unpleasant and occasionally fatal results. *Amanita muscaria* and *Amanita phalloides,* among others, have earned a very unsavory reputation by their ever growing list of fatalities. The danger from these plants is so great that usually only novices are unaware of their appearance and properties. Consequently, their death-roll receives its greatest additions from among foreigners and children. However, cases of mistaken identity have occurred even in the baskets of experienced persons. Among the species of *Amanita* we find many of the most poisonous forms, but other groups have dangerous representatives as well, although none quite so fatal.

The evil reputation of *Amanita muscaria* induced Schmiedeberg and Koppe* to investigate its poison from chemical and pharmacological standpoints. From their careful work it became evident that this plant contained an active principle which they called muscarin. This was at first considered an alkaloid of the general nature of strychnin and morphin, but later work has shown that it is probably a complex ammonia derivative. Muscarin is an extremely active substance and although present in the fungus in small amounts, it is still able to show its characteristic and fatal effects. Muscarin is particularly violent in its action on the nervous system, causing increased secretion, rapid pulse, then paralysis and finally cessation of heart action by stimulating the inhibitory nerve-endings of that organ. All of these effects may be neutralized by the administration of atropin in small doses; the latter being a complete antidote for pure muscarin. Unfortunately,

* Schmiedeberg and Koppe: Das Muskarin. Leipzig, 1869.

however, atropin cannot wholly prevent the harmful effects caused by eating *Amanita muscaria,* possibly because there are other toxic substances present in the plant. Harmsen† held this opinion as a result of his study of this fungus. He found that atropin was not a complete antidote for extracts of *Amanita muscaria,* and furthermore, that weight for weight his preparations from the fresh plant were twice as toxic as pure muscarin. From his experiments upon cats and dogs he calculated that if muscarin *alone* were responsible for the toxic effects of this plant, it would be necessary for a man of average weight to eat *four kilograms* of the fresh fungus in order to receive the lethal dose of pure muscarin. Therefore he postulated the existence of another poison in *Amanita muscaria,* calling it "Pilz-toxin." He claimed that this substance, when separated from muscarin in extracts of the fungus, was not neutralized by atropin, and produced long-continued convulsions and ultimate death. The work of Harmsen upon his "Pilz-toxin" has never been confirmed, but most of the evidence, clinical and otherwise, indicates that muscarin may not be the sole factor involved in cases of poisoning by *Amanita muscaria.* Ford* has also shown that in this species there are present peculiar substances that first cause an agglutination and finally a solution of the red corpuscles of the blood. However, muscarin is probably the toxic substance of greatest importance in *Amanita muscaria* because it withstands heating, whereas the associated materials which affect the blood as above stated, are destroyed by heat, and thus are prevented from acting after the ingestion of the cooked fungi.

Amanita phalloides is even more dangerous than *Amanita muscaria* because there is no known antidote for its poisonous principle. Several investigators have studied the poisons of this plant, but Ford† alone seems to have been able to isolate and learn the properties of its poisonous substances. The results of poisoning

† Harmsen: Zur Toxicologie des Fliegenschwammes. Archiv. f. Expt. Path. u. Pharmacologie. 1906, 1, p. 361.

* Ford: Distribution of poisons in the Amanitas. Jour. Pharmacol. and Expt. Therapeutics. 1909, i, p. 275.

† Ford: Distribution of haemolysins, agglutinins and poisons in fungi, especially the Amanitas, Entolomas, Lactarius and the Inocybes. Jour. Pharmacol. and Expt. Therapeutics. 1911, ii, p. 285. This paper has a complete bibliography.

by *Amanita phalloides* are distinct from those seen in the case of *Amanita muscaria,* since the latter apparently causes death by its action upon the nervous system. These effects are more serious than any caused by the blood-destroying substances found in so many mushrooms. Fortunately, however, the latter are not so important, owing to the ease with which they are destroyed by heat and the digestive juices. Autopsies after fatal *Amanita phalloides* poisoning of people and animals show that most of the internal organs are congested, hemorrhagic, and very seriously affected with necrosis and degeneration. In serious cases death intervenes in a few days, while muscarin poisoning develops in a few hours and runs rapidly to death or complete recovery in a short time. There is no antidote for poisoning by the so-called "amanita-toxin" of *Amanita phalloides,* nor is a rapid recovery to be expected, in view of the grave lesions it causes. As in the case of muscarin, the "amanita-toxin" is not destroyed by cooking. The blood-laking poisons of this same fungus are destroyed by heat and so probably they are always without effect unless the fungus is eaten in the raw state. Schlesinger and Ford* purified the "amanita-toxin" by rigorous chemical methods and obtained final products showing all the characteristic effects of the plant extracts which had been heated to destroy blood-laking substances. They found that the "amanita-toxin" did not seem to belong to the ordinary classes of the powerful poisons, such as the toxalbumins, alkaloids, etc.

Very recently Ford† has reported that in *Inocybe infelix* he found a peculiar poison that resisted heat and drying. In animals it did not produce the effects of muscarin, "amanita-toxin," or of any known mushroom poison. The symptoms came on at once and by their nature seemed to indicate the action of some powerful narcotic poison upon the nervous system. The most striking symptoms were extreme drowsiness, forcible retraction of the head (in rabbits), and complete paralysis lasting several hours. The smaller animals died but the larger ones recovered completely in a few hours. All of these observations seemed to indi-

* Schlesinger and Ford: On the chemical properties of Amanita-toxin. Jour. Biol. Chem., 1907, iii, p. 279.

† Ford: see footnote, page 176.

cate an active narcotic poison of a somewhat unique character. The fact that this *Inocybe* is very closely related to *Inocybe infida* makes Ford's observations very interesting in connection with our own upon this plant, as stated below.

A CASE OF POISONING BY INOCYBE INFIDA

The details of the poisoning by *Inocybe infida* of Dr. W. C. Deming and his family in this vicinity have already been published,* but they will be repeated here for the sake of completeness. We quote from Dr. Deming's own notes made at the time:

"I here transcribe notes made on that or the following evening: June 14, '09, about 11:30 A.M., my son and I gathered about a quart of mushrooms, mostly of the unknown variety and some of

Fig. 1. *Inocybe infida* (Peck) Earle.

the variety frequently eaten. No other kind was gathered. These were stewed and served on toast at 1 P.M. I ate only one half slice with the mushroom thereon, some bread and butter, two cups of weak tea, a little more than one half a stuffed egg, with lettuce and mayonnaise dressing.

"Directly after lunch I smoked one half a cigarette as usual. On finishing this, I began to wonder if this or the mushroom had

* Murrill: A New Poisonous Mushroom. Mycologia, 1909, i, p. 211.

disagreed with me, on account of a slight 'queer' feeling which I cannot accurately describe, but it was so little at first that I dismissed it from my mind. In a few minutes, however, I gradually began to get a fullness in the head and a rapid heart action as if I had taken nitroglycerin. Then I began to sweat, with a feeling of heat over the body, so that my clothing was drenched, even my outer clothing requiring changing later. At the same time there was no nausea nor prostration nor other bad feeling, and I attended to a man with a wound in my office and then to other members of the family without difficulty, though a little confused in mind perhaps. A little after that, perhaps forty-five minutes after eating the mushroom, I washed out my stomach with a tube, and later took about an ounce of castor oil. Soon after, but long before the oil operated, I had a disagreeable sense of pressure, almost pain in the lower bowel, accompanied for a little while by slight abdominal soreness or pain. All symptoms gradually subsided and by evening I was as well as ever except for a little feeling of exhaustion.

"My wife, 25 years old, ate one whole slice of toast with mushrooms, two half eggs stuffed with lettuce and mayonnaise, tea, bread and butter. About half an hour later she felt nauseated and dizzy and lay down. I gave her five glasses of warm water, after which she vomited the egg, but saw no mushrooms. She then took castor oil.

"Mrs. A., 65 years old, ate the same amount of mushrooms, several slices of bread and butter, a cup of tea, but no eggs nor salad. When asked, said she felt slight indigestion, but otherwise well.

"My son, 5 years old, ate same amount, but no eggs nor salad. Immediately after lunch he had a diarrheal movement containing mushrooms. He was given ipecac and warm water and vomited some mushrooms.

"Sophie, maid, aged 30, tasted mushrooms. Felt nauseated soon after. Given mustard and water, but did not vomit. Later, castor oil and was purged and somewhat prostrated. Hattie, maid, aged 38, tasted mushrooms. Belched gas soon after. Not sick. Esther, maid, aged 24, tasted; no effects.

"There was no peculiar taste to the cooked mushrooms, perhaps

a very evanescent bitterness in the raw state. I thought perhaps the combination of the eggs and mayonnaise with the mushrooms had something to do with the effects, as my wife and I, the only ones who ate both in any amount, were the chief sufferers. In my case the beating of the heart, full head and sweating were very marked, though I ate but half as much as the others."

In this case we are fortunate in having a physician's careful description of the symptoms following the meal of harmful mushrooms. It should be noted that these symptoms were caused by the cooked fungi. That fact, taken with the nature of the symptoms, rapidity of recovery, etc., would indicate a toxic substance having more the nature of muscarin than that of blood-laking substances or of the "amanita-toxin," which, under analogous conditions, acts slowly.

EXPERIMENTAL

THE CHEMICAL METHODS OF THE INVESTIGATION

The general features of the clinical data in this case of poisoning seemed to indicate the action of an alkaloid. In some preliminary experiments it was found that the toxic principle could be extracted by hot or cold 95 per cent. alcohol, and that the evaporation residue from such toxic extracts, after being dissolved in water, yielded a slight yellowish precipitate with potassio-mercuric iodide (Mayer's reagent). We then applied to the available specimens of *Inocybe infida* the method of Harmsen* for the preparation of muscarin from *Amanita muscaria*. The air-dry plants of *Inocybe infida* are very small, those of average size usually weighing from 0.1 gram to 0.3 gram. The dry plants were powdered in a coffee-mill and treated as follows:

The powder was extracted twice for twenty-four hour periods with ten times its weight of 95 per cent. alcohol. The extraction was carried out at room-temperature with an occasional thorough shaking. The alcoholic solutions were evaporated to the consistency of a thick syrup on a water-bath. The syrup was extracted with a small volume (15–25 c.c.) of 95 per cent. alcohol. This extract was also evaporated to the consistency of a syrup,

* Harmsen: see footnote, page 176. Slight modifications of the method were introduced.

which, in turn, was thoroughly triturated with powdered glass until a stiff paste was formed. This paste was spread thinly on large watch-glasses and kept in a vacuum desiccator over sulphuric acid for a week. The desiccator was frequently exhausted.

The resultant dry friable mass was then extracted with three successive small portions of absolute alcohol. These solutions were combined, evaporated to dryness on a water-bath, treated with a small volume of water and filtered free from the large amount of fatty matter which separated out. The filtrate was usually clear and colorless, and neutral or slightly alkaline to litmus. When 40 grams of material were used, the volume of the final aqueous solution was about ten cubic centimeters. By evaporation, this volume of solution yielded from 0.05–0.15 gram of a semi-crystalline residue.

The modified method just outlined was adopted after several other variations of it had been tried. For instance, Harmsen used boiling alcohol to extract his material, but in our hands it was not as satisfactory as the cold alcohol, because the hot solvent dissolved a larger amount of gummy matter, and besides, such residues showed no greater toxicity than those obtained by extraction with cold alcohol. The success of this extraction method depends upon the repeated purifications that result from re-solution of the syrupy evaporation residues with fresh alcohol, and also upon the complete drying of the powdered-glass-syrup mixture in the desiccator. When the residue from the absolute alcohol extract was treated with water, a bulky insoluble portion was separated. The small amount of aqueous filtrate was used for injection into frogs.

The fact already mentioned, that potassio-mercuric iodide precipitated yellowish material when added to the *Inocybe* extract, led to the use of this reagent for the purification of the toxic substance. The method of alkaloid purification, as finally adopted, was that recommended by Dragendorff,* which was conducted as follows:

The aqueous filtrate obtained in the last phase of the Harmsen

* Dragendorff: Plant Analysis, translated by Greenish. London, 1884, pp. 57–8.

process was made slightly acid with sulphuric acid, and then treated with a moderate excess of potassio-mercuric iodide solution. A yellowish amorphous precipitate formed at once, and after heating the mixture for an hour on a water-bath, the precipitate was allowed to settle over night. Filtration through double filters was often necessary to remove the colloidal precipitate. The thoroughly washed precipitate was then suspended in hot water and decomposed with hydrogen sulphide, while the mixture was still hot. After this treatment the mercury sulphide could be filtered off readily, especially if the mixture was first allowed to stand on a steam-bath for an hour or more. The filtrate contained some free hydriodic acid and also the compound of the toxic substance with hydriodic acid. The *careful* addition of silver sulphate, in the form of a saturated aqueous solution of that substance, until no further precipitate was obtained, followed by boiling for a short time, served to decompose and precipitate all iodine derivatives. The yellow silver iodide was then filtered off and the sulphuric acid in the filtrate removed by precipitation with an excess of barium carbonate. The clear filtrate, from the resultant barium sulphate plus the physical excess of barium carbonate, contained any alkaloidal substance that occurred in the specimens under examination. We evaporated this aqueous solution to 10–15 c.c. on a water-bath and used small portions of it in the pharmacological tests on frogs as indicated below.

Thinking that cholin, resulting from the decomposition of lecithins in the fungi, might be present with the toxic substance in the final filtrates, we tested all of the latter for cholin. Rosenheim's* periodide test offers a beautiful and characteristic means of detecting cholin. Practically all the extracts were found to contain it. For the detection of cholin one adds a drop of platinum chloride solution to the liquid to be tested, which may be only a few drops on a microscope slide. After allowing the water to evaporate, the feathery and prismatic colorless crystals of the cholin-platinum chloride and of the excess of platinum chloride may be easily detected under the microscope. When these crystals

* Rosenheim: New Tests for Choline in Physiological Fluids. Jour. of Physiol. 1905, xxxiii, pp. 220–4.

are treated with a drop or two of Lugol's solution,* the microscopical appearance gradually changes; the original crystals slowly disappear, the whole field becomes darker, and finally characteristic brown platelets come to view in large numbers. The cholin periodide crystals have a great similarity to the "haemin" crystals obtained in Teichmann's test for hemoglobin. Upon evaporation of the water, the crystalline plates lose their form and change into oily drops, which immediately resume their characteristic form when more Lugol's solution is added.

Before applying the extraction and alkaloidal separation methods to *Inocybe* we tested them upon samples of *Amanita muscaria* to determine the efficacy of our procedures. The methods were found to be satisfactory.

TOXICOLOGICAL EXPERIMENTS

In our experiments to determine the toxicity of extracts upon frogs we used lively animals weighing from 25 to 40 grams. All injections were made into the dorsal lymph-sac except in a few cases, when the toxic solution was given by mouth through a small narrow pipette. A description of these experiments follows.

EXPERIMENTS WITH AMANITA MUSCARIA. Twenty-five grams of air-dry specimens were treated and extracted as already described, but no attempt was made to apply the alkaloidal separation process. The final volume of the aqueous solution was 15 c.c., which on evaporation to dryness yielded 0.18 gram of a waxy, semicrystaline residue. This residue gave a striking Rosenheim cholin test.

Experiment 1. July 14, 1910. Frog 2. Weight, 27 grams. Received an injection of 1 c.c. of *Amanita muscaria* extract at 2.36 P.M.

2.38 P.M. Paralyzed after excitement.
2.41 P.M. Paralyzed, very slight muscular reflexes.
2.47 P.M. Heart stopped in diastole.

Experiment 2. July 14, 1910. Frog 3. Weight, 31 grams. At 9.58 A.M. received an injection of 0.5 c.c. of the extract administered to the frog in Experiment 1.

* Lugol: Lugol's solution contains 4 grams of iodine and 6 grams of potassium iodide dissolved in 100 c.c. of water.

10.02 A.M. Paralyzed.

10.15 A.M. Apparently recovered.

10.20 A.M. Paralyzed again.

10.27 A.M. Heart stopped in diastole.

The remainder of the available air-dry specimens (20 grams) was extracted according to Harmsen's scheme and the residue thus obtained was subjected to the alkaloidal separation process already outlined. A small amount of a waxy residue was the outcome of this treatment. This residue weighed 0.07 gram. It was dissolved in 10 c.c. of water. This solution also responded to the test for cholin.

Experiment 3. August 11, 1910. Frog 11. Weight, 29 grams. Received an injection of 1 c.c. of extract at 4.27 P.M.

4.31 P.M. Completely paralyzed.

4.35 P.M. Heart stopped.

EXPERIMENTS WITH INOCYBE INFIDA. FIRST GROUP. Twenty grams of pulverized *Inocybe infida* were extracted in the usual way and the final residue, weighing 0.21 gram, was dissolved in 10 c.c. of water. The residue was greenish and semi-crystalline. Its solution was slightly alkaline to litmus. This extract was not subjected to the alkaloidal separation process.

Experiment 4. July 15, 1910. Frog 8. Weight, 35 grams. Received an injection of 1 c.c. of *Inocybe* extract at 2.30 P.M.

2.37 P.M. Lethargic. Swallowing motions.

2.55 P.M. Lethargic. Swallowing motions. Began to appear bloated. July 16, 10.30 A.M. Heart stopped. Animal bloated.

Experiment 5. July 15, 1910. Frog 9. Weight, 26 grams. At 3.56 P.M. received an injection of 2 c.c. of the extract administered to the frog in Experiment 4.

4.01 P.M. Nearly paralyzed.

4.17 P.M. Wholly paralyzed.

4.21 P.M. Heart stopped.

Forty grams of pulverized *Inocybe infida* were extracted and treated in the usual manner. The residue, which was waxy and greenish in color, weighed 0.36 gram. It was dissolved in 20 c.c. of water. This solution contained cholin, as was indicated by the periodide test. The alkaloidal separation process was not applied to it.

Experiment 6. July 26, 1910. Frog 10. Weight, 31 grams. Received an injection of 1 c.c. of this extract at 2.55 P.M.

3.15 P.M. Lethargic.

5.30 P.M. Partly paralyzed.

July 27, 9.30 A.M. Apparently normal.

Experiment 7. July 28, 1910. Frog 10a. Weight, 28 grams. At 2.06 P.M. received an injection of 1.5 c.c. of the extract administered to the frog in Experiment 6.

2.12 P.M. Partly paralyzed.

3.30 P.M. Wholly paralyzed.

July 29, 9.20 A.M. Apparently normal.

Experiments 6 and 7 were repeated in every particular, with a new extract. The final residue weighed 0.43 gram. It was dissolved in 20 c.c. of water. The test for cholin was positive.

Experiment 8. January 20, 1911. Frog 16. Weight, 33 grams. Received an injection of 1 c.c. of this extract at 3.12 P.M.

3.16 P.M. Excited.

3.23 P.M. Very lethargic, partly paralyzed.

3.30 P.M. Wholly paralyzed.

4.00 P.M. Recovering. Bloated. Partly paralyzed.

4.30 P.M. Slightly paralyzed.

January 21, 9.10 A.M. Lethargic (?), bloated.

4.00 P.M. Normal, bloated (?).

Experiment 9. January 19, 1911. Frog 17. Weight, 37 grams. At 4.07 P.M. received an injection of 1 c.c. of the extract administered to the frog in Experiment 8.

4.13 P.M. Excited.

4.25 P.M. Very lethargic.

4.40 P.M. Lethargic and partly paralyzed.

January 20, 9.00 A.M. Lethargic and bloated.

January 21, 9.15 A.M. Normal.

SECOND GROUP. The evaporated remainders of the *Inocybe* extracts prepared for use in Experiments 4–9 were combined, redissolved, and the alkaloidal separation process applied to the resulting solution. The precipitate given with potassio-mercuric iodide was light in color and in such a finely divided state that it was filtered off with difficulty. The precipitate was not as yellow as that from *Amanita muscaria*, nor was it as crystalline in ap-

pearance. The final residue was greenish and weighed 0.13 gram The test for cholin was positive. The solution was neutral to litmus.

Experiment 10. February 13, 1911. Frog 18. Weight, 24 grams. Received an injection of 1 c.c. at 2.07 P.M.

2.25 P.M. Excited.

2.32 P.M. Partly paralyzed.

2.35 P.M. Completely paralyzed.

4.30 P.M. Lethargic and partly paralyzed.

February 14, 9.15 A.M. Apparently normal.

EXPERIMENTS WITH CLITOCYBE MULTICEPS. Having already studied the action of extracts of the poisonous *Amanita muscaria* and the questionable *Inocybe infida,* we performed similar experiments with comparable extracts of *Clitocybe multiceps,* which is known to be harmless. This plan was intended to serve as a "control" of our previous procedure and to show whether we had introduced poisonous material into our extracts during their preparation. About 50 grams of dried *Clitocybe multiceps* were treated in the usual manner and finally 0.23 gram of a waxy residue was obtained. This residue was dissolved in 10 c.c. of water. The solution seemed to be slightly alkaline to litmus. The test for cholin was very pronounced, in fact, it was the most striking of any yet observed by us in this study.

Experiment 11. October 14, 1910. Frog 13. Weight, 35 grams. Received an injection of 1 c.c. of the extract at 9.47 A.M.

10 A.M. No symptoms.

12 M. Normal and continued so.

Experiment 12. October 14, 1910. Frog 14. Weight, 25 grams. At 10.50 A.M. received an injection of 2 c.c. of the extract administered to the frog in Experiment 11.

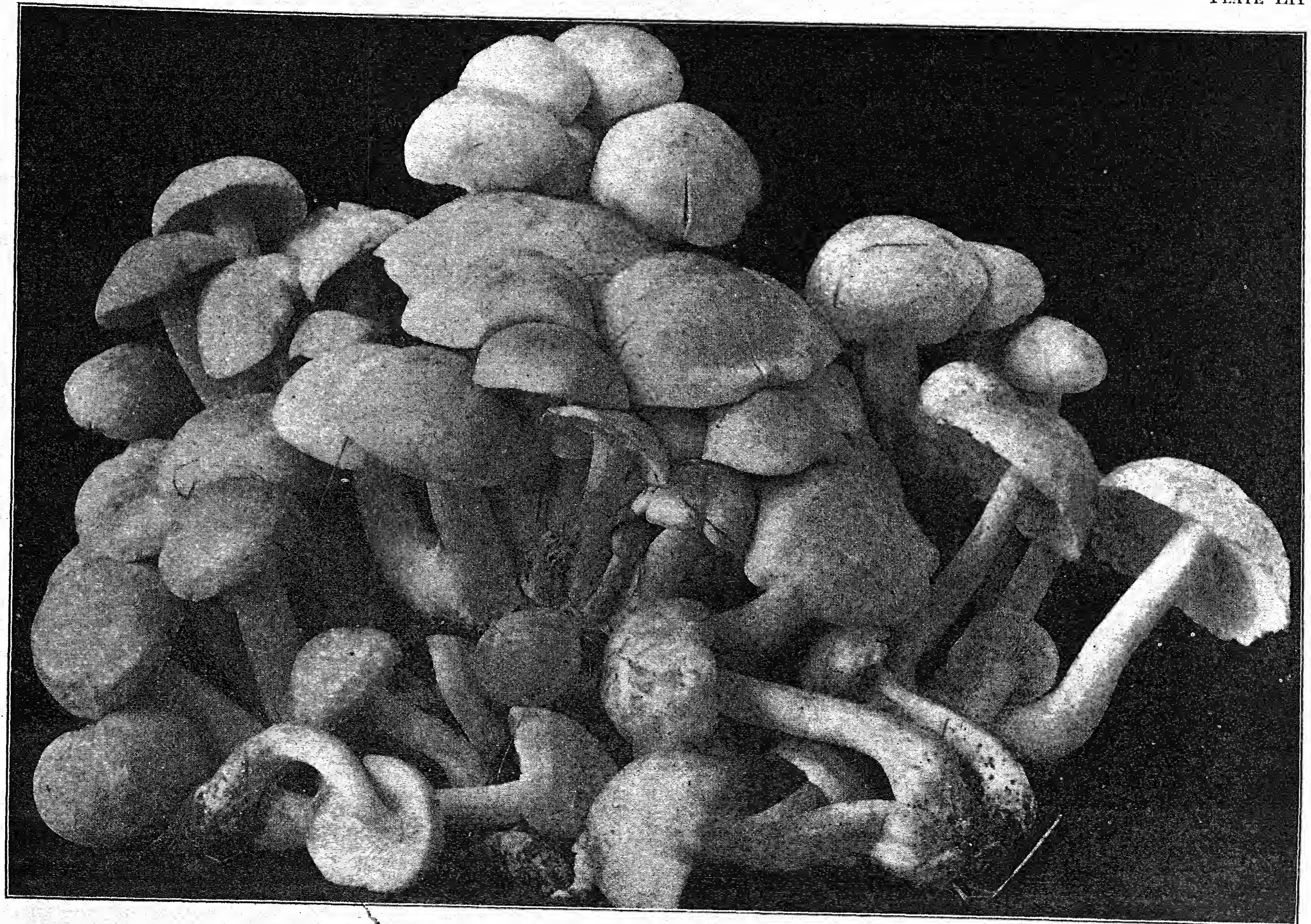
11.25 A.M. No symptoms.

12.00 M. Slightly lethargic (?).

12.45 P.M. Normal.

October 15, 9.10 A.M. Normal and continued so.

The remainder of the extract prepared for use in Experiments 11 and 12 was treated according to Dragendorff's method for the separation of alkaloids. The resultant residue weighed 0.05 gram. It was dissolved in 10 c.c. of water. The solution was slightly



SOME SPECIMENS OF CLITOCYBE MULTICEPS PECK USED IN THE EXPERIMENTS

alkaline to litmus. Apparently there was no cholin in it, for there was no response to the Rosenheim test.

Experiment 13. October 24, 1910. Frog 15. Weight, 28 grams. Received an injection of 1 c.c. of the extract at 4.07 P.M.

4.17 P.M. Normal.

5.05 P.M. Normal.

October 25, 9.05 A.M. Normal.

Experiment 14. October 28, 1910. Frog 13a. Weight, 32 grams. At 2.28 P.M. received an injection of 1 c.c. of the extract administered to the frog in Experiment 13.

3.02 P.M. Normal.

3.25 P.M. Normal.

4.50 P.M. Normal.

Experiment 15. October 28, 1910. Frog 20. Weight, 35 grams. At 4.50 P.M. received, *per os,* 1 c.c. of the extract administered to the frog in Experiments 13 and 14.

5.05 P.M. Excited (?).

5.20 P.M. Normal.

5.50 P.M. Normal.

SUMMARY OF CONCLUSIONS

Inocybe infida, when subjected to processes of extraction and purification that separate muscarin from *Amanita muscaria,* yields material which exerts definite toxic effects upon frogs. These effects are quite different from those produced by muscarin as obtained, by the same method, from *Amanita muscaria.* A prolonged state of lethargy, often with complete recovery after twelve or fifteen hours in this condition, was a constant factor in our toxicological experiments with this *Inocybe.* The poison seems to be of the narcotic type recently found by Ford in *Inocybe infelix.*

The poison of *Inocybe infida* seems to belong chemically to the class of alkaloids or related substances. The plants of this species are small. A very much larger supply of these mushrooms than the available quantity will be required for the isolation and chemical identification of the toxic material.

Dr. William A. Murrill called Professor Gies' attention to the

case of poisoning in Dr. Deming's family (p. 178) and suggested the desirability of an inquiry into the cause. At Professor Gies' request we conducted these experiments. The sincere thanks of the writers are due to Professor Gies for his interest and suggestions. Dr. Murrill very kindly supplied us with the fungi used in this work, and to him also our thanks are due.

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THE AGARICACEAE OF TROPICAL NORTH AMERICA—III

William A. Murrill

The introductory remarks used in the last article of this series apply in a general way to the genera here treated; most of them belong to temperate regions and are scantily represented in the tropics except at high elevations. The genus *Hydrocybe* seems to delight in the moist mountain tops where tree-ferns grow, and a number of endemic species have been developed in these peculiar and segregated localities. It was my good fortune to be admirably situated at Cinchona, Jamaica, at 5,000 feet elevation, for the study of many species of this genus, and to have Mrs. Murrill with me to make colored drawings from the freshly gathered specimens.

The following simple key may be used to distinguish these genera. They all contain fleshy, central-stemmed species, but none of them possess a volva and only two are furnished with the rudiments of an annulus. The temperate species far exceed those of the tropics, both in number and abundance.

Lamellae fleshy, not waxy, though apparently so in *Laccaria*.
  Lamellae adnate; spores echinulate. — 1. Laccaria.
  Lamellae decurrent.
    Sporophore solitary or gregarious. — 2. Clitocybe.
    Sporophore densely cespitose. — 3. Monadelphus.
  Lamellae sinuate or adnexed. — 4. Melanoleuca.
Lamellae waxy at maturity, translucent or watery in appearance.
  Veil absent; pileus usually bright-colored. — 5. Hydrocybe.
  Veil present; pileus not bright-colored. — 6. Hygrophorus.

1. Laccaria Berk. & Br. Ann. Nat. Hist. 370. 1883

Russuliopsis Schröt. Krypt. Fl. Schles. 3^1: 622. 1889.

This genus is distinguished from *Clitocybe* by its echinulate spores and adnate gills.

LACCARIA LACCATA (Scop.) Berk. & Br.
Ann. Nat. Hist. 370. 1883

Clitocybe laccata Quél. Champ. Jura Vosg. 55. 1872.

No attempt is here made to list the synonyms of this common and well-known temperate species, which is probably confined to the higher elevations of our tropics, being abundant at Cinchona, Jamaica.

Cinchona, Jamaica, *W. A. & Edna L. Murrill 547, 599;* Cuba, *Wright;* Jalapa, Mexico, *W. A. & Edna L. Murrill 2.*

2. CLITOCYBE (Fries) Quél. Champ. Jura Vosg. 48. 1872

The distinguishing feature of this very important temperate genus is its decurrent gills. Some of the species, however, do not show this character very conspicuously.

1. **Clitocybe niveicolor** sp. nov.

Entire sporophore snowy-white, gregarious in moist humus; pileus compressed-convex, reaching 7 mm. in diameter; surface smooth, glabrous, appearing subtomentose when dry because of the loosely woven context, margin slightly irregular, decurved; lamellae decurrent, distant, slightly arcuate; spores ovoid, smooth, hyaline, $12 \times 7\mu$; stipe cylindric, slightly tapering upward, glabrous, fleshy, fistulose, 1–1.5 cm. long, 1 mm. thick above, 1.5 mm. below.

Type collected on the ground in a moist virgin forest covering a mountain side near Motzorongo, Mexico, 1,000 ft. elevation, January 15, 1910, *W. A. & Edna L. Murrill 1058.*

3. **Clitocybe troyana** sp. nov.

Pileus subhemispheric, regular, solitary, 1 cm. broad; surface dry, smooth, glabrous, pale-isabelline; margin regular, concolorous, incurved on drying; lamellae decurrent, rather crowded, white; spores ovoid, smooth, hyaline, $5 \times 4\mu$; stipe straight, tapering upward, subconcolorous, glabrous, 2.5 cm. long, 1–1.5 mm. thick.

Type collected on the ground in woods, Troy and Tyre, Jamaica, January 12–14, 1909, *W. A. Murrill & W. Harris 931.*

4. **Clitocybe incrustata** sp. nov.

Pileus turbinate, with conic umbo, solitary, 2 cm. broad, nearly 1 cm. high; surface smooth, glabrous, dry, pallid with a rosy tint, light-bay on the umbo, becoming incrusted on drying with a white, powdery substance readily soluble in water; margin thin, straight, concolorous; lamellae decurrent, few in number, dull-white; spores ovoid, smooth, hyaline, 8–10 × 5–7 μ; stipe curved, cylindric, subequal, glabrous, white, 4 cm. long, 4 mm. thick.

Type collected in rich soil on a wet bank at Chester Vale, Jamaica, 3,000 ft. elevation, December 23, 1908, *W. A. & Edna L. Murrill 298*. The powdery substance covers about one third of the surface and is distributed in radiating patches or streaks.

5. **Clitocybe testaceoflava** sp. nov.

Pileus obconic in outline, deeply umbilicate, irregularly oval in cross section, solitary, 3–5 cm. broad; surface dry, distinctly tomentose, dilute-testaceous, margin irregularly undulate, incurved, concolorous; lamellae decurrent, rather distant, stramineous, edges undulate; spores ellipsoid, smooth, slightly yellowish, 4–5 × 3 μ; stipe cylindric, subequal, curved, slightly paler than the surface of the pileus, white near the base, 3–4 cm. long, 3 mm. thick.

Type collected under low bushes on a bank at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 543*.

6. **Clitocybe mexicana** sp. nov.

Pileus convex to depressed, irregularly lobed, gregarious, scarcely cespitose, 7 cm. broad; surface smooth, glabrous, nearly white, with an avellaneous-isabelline tint, margin striate, involute when young; context 1 cm. thick at the center, milk-white, sweet, odor none when fresh, but strong and not unpleasant on drying; lamellae decurrent, close, rather narrow, tapering at each end, pale watery-white; spores fusiform, smooth, hyaline, 7 μ long; stipe enlarging slightly above, dealbate, glabrous, finely tomentose near the base, hollow, white inside, with a tough rind, 7 cm. long, nearly 2 cm. thick.

Type collected on the ground among humus in a moist virgin forest near Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 137*.

7. **Clitocybe Broadwayi** sp. nov.

Gregarious to subcespitose, rather large, abundant, strongly suggesting *Tricholoma alboflavidum,* but with distinctly decurrent gills; pileus thin, convex, often indented on the side next to the stipe owing to its clustered arrangement, 5–8 cm. broad; surface glabrous, faintly radiate-striate, dry, white or pale-isabelline, depressed to umbilicate; margin incurved, concolorous, blackening when bruised; lamellae decurrent, close, narrow, white; spores ellipsoid, smooth, hyaline, $5–7 \times 3.5–4.5\,\mu$; stipe curved, cylindric, usually equal, glabrous, toughish, slightly reddish-brown, twisted and finely grooved when dry, suggesting asbestos, 5–7 cm. long, 2–4 mm. thick.

Type collected on the ground among leaves in a cocoa plantation at Tanteen, St. George's, Grenada, August 23, 1905, *W. E. Broadway.* Also collected in Grenada by Broadway in September, 1905.

DOUBTFUL AND EXCLUDED SPECIES

Most of these will be found treated under *Monadelphus, Omphalia,* and *Marasmius. Clitocybe rivulosa,* reported from the West Indies by Fries, is a European plant, and no specimens of it from tropical America have been seen in any of the herbaria examined. *Clitocybe pachylus* Berk. & Curt., from Cuba, is probably undescribed.

3. MONADELPHUS Earle, Bull. N. Y. Bot. Garden 5: 432. 1909

This genus was founded by Earle to receive the cespitose species of *Clitocybe,* the type being *C. illudens.*

Monadelphus caespitosus (Berk.)

Lentinus caespitosus Berk. Hook. Lond. Jour. Bot. **6**: 317. 1847. (Type from Ohio.)

Agaricus (*Pleurotus*) *caespitosus* Berk. Jour. Linn. Soc. **10**: 287. 1868.

Agaricus monadelphus Morgan, Jour. Cinc. Soc. Nat. Hist. **6**: 69. 1883. (Type from Ohio.)

Clitocybe monadelpha Sacc. Syll. Fung. **5**: 164. 1887.

Pleurotus caespitosus Sacc. Syll. Fung. **5**: 352. 1887.

A rather common species in the southern United States, ranging north to New York and west to Kansas. At Kew, it is represented by specimens from South Carolina and Ohio only, those from Cuba bearing this name being an entirely different plant. Fries knew the species well, so we may infer that Liebmann's specimens from Orizaba, Mexico, were correctly determined, although they appear to have been lost. This species has the habit and general form, but neither the brilliant coloring nor the poisonous properties, of *M. illudens*. It is difficult to distinguish from certain forms of *Armillaria mellea*, which also occurs in dense clusters about old stumps but is usually furnished with a veil. The spores of *M. caespitosus* are broadly ovoid, smooth, hyaline, $7 \times 5\,\mu$.

Orizaba, Mexico, *Liebmann;* British Honduras, *Morton E. Peck.*

4. MELANOLEUCA Pat. Tax. Hymén. 159. 1900

Tricholoma (Fries) Quél. 1872. Not *Tricholoma* Benth. 1820.

This genus, usually known as *Tricholoma*, is abundantly represented in temperate regions. It differs from *Clitocybe* chiefly in its sinuate or adnexed, instead of decurrent, gills.

1. **Melanoleuca holoporphyra** (Berk. & Curt.)

Agaricus (*Clitocybe*) *holoporphyrus* Berk. & Curt. Jour. Linn. Soc. **10**: 284. 1868.

Described from Wright's Cuban collections, and said to grow on rotten logs in woods. The types at Kew have been examined. My own notes, supplemented by a colored drawing, are as follows: "Pileus convex, 6 cm. broad; surface latericious, dry, finely tomentose, slightly striate on the margin; lamellae sinuate with a decurrent tooth, broad, distant, testaceous; spores ovoid, smooth, hyaline, $9–12 \times 4–7\,\mu$; stipe equal, pale-purple, glabrous, hollow, with a fibrous-looking rind, 6×1 cm. Solitary in rich soil in coffee plantations along the Rio Blanco, January 17, 1910."

Xuchiles, Mexico, *W. A. & Edna L. Murrill 1125.*

2. **Melanoleuca dichropus** (Fries)

Agaricus (*Tricholoma*) *dichropus* Fries, Nova Acta Soc. Sci. Upsal. III. **1**: 22. 1851.

This beautiful species was collected in the island of St. Thomas by Oersted, who made a colored drawing of it which may still be seen at Copenhagen, but no trace of the fungus itself was discovered either in Denmark or in Sweden. The pileus is represented as dilute wine-colored, with a purple center, and the stipe is concolorous except at the apex, where it abruptly changes to white. The general form of the plant is more like *Lepiota* than *Melanoleuca*.

3. **Melanoleuca jamaicensis** sp. nov.

Pileus umbilicate, solitary, 2–3 cm. broad; surface glabrous, latericious-fulvous; lamellae sinuate with a decurrent tooth, latericious, broad, rather distant; spores globose, smooth, hyaline, 3–4 μ; stipe slender, cylindric, equal, glabrous, concolorous with the surface of the pileus, 4 cm. long, 2.5 mm. thick, the apex much enlarged, 5 mm. thick, stramineous, and tomentose.

Type collected on the ground under tree-ferns at Morce's Gap, Jamaica, 5,000 ft. elevation, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 72c.* The fresh plant has the appearance of *Clitocybe proxima* Boud.

4. **Melanoleuca subisabellina** sp. nov.

Pileus irregular, convex to infundibuliform, gregarious, 4–8 cm. broad; surface glabrous, dull-colored, dingy-isabelline, margin undulate or slightly lobed, inflexed; lamellae sinuate, straight, narrow, rather close, white to dirty-brownish; spores ellipsoid, hyaline, $5 \times 3.5\ \mu$, with minute, short prickles; stipe curved, tapering toward the base, glabrous, fleshy, white, 3 cm. long, 3–10 mm. thick.

Type collected on a waste heap of earth and vegetable refuse in Castleton Gardens, Jamaica, December 14, 15, 1908, *W. A. & Edna L. Murrill 45.*

5. **Melanoleuca jalapensis** sp. nov.

Pileus convex, much split at the margin, solitary, 4 cm. broad; surface dry, glabrous, shining, more or less radiate-rimose, the castaneous cuticle remaining entire at the center, but almost disappearing near the margin, where it persists in faint streaks or patches; context thin, white, sweet; lamellae adnate with a slight sinus, narrow, rather close, cremeous, pruinose under a lens; spores globose, smooth, hyaline, 5 μ; stipe cylindric, equal, gla-

brous, white, with a tough rind, 4 cm. long, 7 mm. thick, abruptly bulbous at the base as in some species of *Clitocybe* and *Cortinarius*.

Type collected on rich soil in a moist virgin forest near Jalapa, Mexico, December 12–20, 1909, *W. A. & Edna L. Murrill 85*.

DOUBTFUL SPECIES

Agaricus (*Tricholoma*) *sordidus* Fries, Epicr. Myc. 53. 1838. Reported from St. Thomas by Fries in Nova Acta Soc. Sci. Upsal. III. 1 : 23. 1851, who identified one of Oersted's collections as this species. No trace of the specimens in question were found in Europe.

5. **Hydrocybe** (Fries) Karst. Hattsv. 233. 1879

This genus, usually known as *Hygrophorus*, contains many brilliantly colored members in temperate regions, some of the commonest of which were described and illustrated in MYCOLOGIA for July, 1910.

1. **Hydrocybe albo-umbonata** sp. nov.

Pileus conic, with long cylindric umbo, solitary, 2.5 cm. broad, nearly 2 cm. high; surface smooth, glabrous, moist, white; lamellae broad, ventricose, thin, white; spores subglobose, smooth, hyaline, 5–7 μ; stipe curved, terete, equal, glabrous, moist, white, 5 cm. long, 2 mm. thick.

Type collected on the ground in woods at New Haven Gap, Jamaica, 5,600 ft. elevation, January 4, 1909, *W. A. & Edna L. Murrill 764*.

2. **Hydrocybe aurantia** sp. nov.

Pileus obconic, small, solitary, 1.5 cm. broad; surface smooth or slightly striate, glabrous, dry or moist, aurantiacous, lamellae adnate, rather broad and distant, subconcolorous; spores globose, smooth, hyaline, 3–5 μ; stipe slightly tapering downward, glabrous, aurantiacous, pruinose at the apex, 2.5 cm. long, about 2 mm. thick.

Type collected on the ground in woods at Morce's Gap, Jamaica, 5,000 ft. elevation, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 743*.

3. **Hydrocybe bella** (Massee)

Hygrophorus bellus Massee, Jour. Bot. **30**: 161. 1892.

Type collected on the ground in woods in the Nariaqua Valley, St. Vincent, by W. R. Elliott. A large scarlet species with decurrent gills and immense ellipsoid spores 18 × 10 μ.

4. **Hydrocybe Cantharellus** (Schw.)

Agaricus (Omphalia) Cantharellus Schw. Schr. Nat. Ges. Leipzig, **1**: 88. 1822.

Hygrophorus Cantharellus Fries, Epicr. Myc. 329. 1838.

A very pretty little species, resembling *Omphalia* but brilliantly colored, common in many varieties from Maine to Alabama and west to Minnesota. The spores of the tropical specimens are ellipsoid, smooth, hyaline, 8–9 × 5 μ.

Castleton Gardens, Jamaica, *Earle 227;* New Haven Gap, Jamaica, 5,600 ft. elevation, *W. A. & Edna L. Murrill 760.*

5. **Hydrocybe Earlei** sp. nov.

Pileus convex, solitary, 3 cm. broad; surface glabrous, silky-shining, not striate, pale reddish-yellow; context yellow, mild; lamellae slightly adnexed, crowded, broad, ventricose, cremeous; spores globose, smooth, hyaline, 7 μ; stipe somewhat flattened, equal, hollow, glabrous, shining, pale-yellow, 5–6 cm. long, 4–6 mm. thick.

Type collected on the ground in a pasture at Herradura, Cuba, June 16, 1907, *F. S. Earle 562.*

6. **Hydrocybe flavolutea** sp. nov.

Pileus convex, solitary, 1.3 cm. broad, 5 mm. high; surface luteous, with faint traces of red, polished, slightly viscid, radiate-striate; lamellae flavous, slightly ventricose, rather close, several times inserted, apparently free, but really connected by slender threads of tissue across the disk to which the stipe is attached; spores globose, regular, hyaline, uninucleate, smooth, 4–5 μ; stipe cylindric, equal, smooth, glabrous, citrinous, whitish-tomentose and slightly enlarged at the base, 2.2 cm. long, 1.5 mm. thick.

Type collected in soil on a bank at Cinchona, Jamaica, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 527.* Also collected at Jalapa, Mexico, December 12–20, 1909, *W. A. & Edna L. Murrill 35, 110.*

7. **Hydrocybe hondurensis** sp. nov.

Pileus convex to plane, slightly depressed, solitary, 1–1.5 cm. broad; surface luteous, very viscid, radiate-striate; lamellae short-decurrent, rather narrow, inserted; spores ovoid, smooth, hyaline, $5 \times 3.5\,\mu$; stipe equal, concolorous, very viscid, 3–4 cm. long, 1–2 mm. thick.

Type collected in rich soil in British Honduras, 1906, *Morton E. Peck.*

8. **Hydrocybe rosea** sp. nov.

Pileus convex with an umbilicate center, resembling *Omphalia* in shape, solitary, 1 cm. broad, 5 mm. high; surface smooth, glabrous, not viscid, roseous to incarnate, margin entire or rarely lobed, decurved; context very thin, allowing the lamellae to show through on the upper side; lamellae decurrent, arcuate, white, stained with red; spores ovoid, smooth, hyaline, $10\text{–}13 \times 7\text{–}9\,\mu$; stipe smooth, cylindric, paler than the pileus below, deep-red at the apex, where it is much enlarged, 1.5 cm. long, 1 mm. thick below.

Type collected in moss on a decayed log on Sir John Peak, Jamaica, 6,000 ft. elevation, January 5, 1909, *W. A. Murrill 811.*

9. **Hydrocybe subcaespitosa** sp. nov.

Pileus convex to plane or depressed, subcespitose, 2–3 cm. broad; surface smooth, glabrous, ruber when young, miniatous when older; lamellae white to stramineous, adnate or slightly decurrent, broad, inserted; spores oblong-ellipsoid, smooth, hyaline, $8\text{–}9 \times 5\,\mu$; stipe thick, cylindric to slightly flattened, smooth, glabrous, luteous or paler yellowish, about 3 cm. long, 5 mm. or more thick.

Type collected on rich soil under tree-ferns at Morce's Gap, Jamaica, 5,000 ft. elevation, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 750.*

10. **Hydrocybe subflavida** sp. nov.

Pileus conic to subcampanulate, umbonate, gregarious, reaching 5 cm. broad and 3 cm. high; surface pale-flavous, dull-luteous in very young stages and on the umbo, moist, smooth, becoming striate in old or wet specimens; lamellae adnate with decurrent tooth, broad, ventricose, rather distant, pale-yellow; spores globose, smooth, hyaline, $5\,\mu$; stipe cylindric, equal, pale-flavous, glabrous, 4–5 cm. long, 4–7 mm. thick.

Type collected on the ground under tree-ferns at Morce's Gap, Jamaica, 5,000 ft. elevation, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 674.*

11. **Hydrocybe subminiata** sp. nov.

Pileus convex to plane, at length irregular, 1.5 cm. broad; surface viscid, smooth, miniatous, varying slightly in places, margin undulate; lamellae decurrent, few, whitish to ochraceous; spores oblong-ellipsoid, often constricted at the middle, smooth, hyaline, about $9 \times 5\,\mu$; stipe terete, crooked, slightly enlarged above, glabrous, luteous, 3 cm. long, 2 mm. thick.

Type collected in soil on a shaded bank at Chester Vale, Jamaica, 3,000 ft. elevation, December 23, 1908, *W. A. & Edna L. Murrill 369.* Also collected on the ground under tree-ferns at Morce's Gap, Jamaica, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 672.* What appears to be the same species was collected near Santiago de las Vegas, Cuba, September 11, 1904, *F. S. Earle 181.*

12. **Hydrocybe troyana** sp. nov.

Pileus subhemispheric to convex, solitary, 1–1.5 cm. broad, 3 mm. high; surface smooth, viscid when wet, ferruginous; lamellae decurrent, violaceous, distant, rather broad, two or three times inserted; spores ellipsoid, smooth, hyaline, $7–9 \times 4–5\,\mu$; stipe glabrous, cylindric, latericious above, paler below, changing to flavous at the base, 4 cm. long, 2.5 mm. thick.

Collected on the ground in Troy and Tyre, Jamaica, January 12–14, 1909, *W. A. Murrill & W. Harris 1078 (type), 1090.* This is a smaller species than *H. coccineus,* with ferruginous hues on the surface of the pileus and violet-tinted lamellae.

DOUBTFUL SPECIES

Hygrophorus miniatus Fries, Epicr. Myc. 330. 1838. This common temperate species has been reported by Duss upon various kinds of dead wood in Guadeloupe.

Hygrophorus? variolosus Fries, Nova Acta Soc. Sci. Upsal. III. 1: 29. 1851. Described from collections in Costa Rica by Oersted, who made colored drawings of fresh specimens and also preserved some in alcohol. These specimens could not be found

in Europe, but the drawings strongly suggest *Chamaemyces alphitophyllus*.

6. HYGROPHORUS Fries, Gen. Hymen. 8. 1836

Lymacium (Fries) Schröt, Krypt. Fl. Schles. 3^1: 330. 1889.

This genus in its present limitation includes species provided with a veil, which is glutinous and often inconspicuous.

1. **Hygrophorus subpratensis** sp. nov.

Pileus convex, obtuse, gregarious, 3–4 cm. broad; surface pale-fuscous when young, becoming pallid or whitish with darker disk, slimy-viscid, not striate, pellicle separable; context white, unchanging, odor and taste mild; lamellae deeply sinuate, broad, crowded, white; spores globose or subglobose, smooth, hyaline, 5 μ; stipe cylindric, equal, slimy-viscid, white, solid but spongy, 3–4 cm. long, 3–4 mm. thick; veil slimy-viscid, scarcely leaving an annulus.

Type collected on lawns at Santiago de las Vegas, Cuba, June 1, 1905, *F. S. Earle 373*. Also collected on banana trash in the some locality, June 16, 1904, *F. S. Earle 68*.

2. **Hygrophorus montanus** sp. nov.

Pileus plane or convex, smooth, depressed, gregarious, 2.5 cm. broad; surface smooth, viscid, stramineous to isabelline, with a testaceous tint, margin incurved, white, entire; lamellae adnexed, rather broad, yellowish-white, discolored in blotches on drying, pruinose on the edge; spores pip-shaped, smooth, faintly yellowish, 8–10 $\times$ 4–5 μ; stipe shining, watery-white, smooth, cylindric, equal, fleshy-fibrous, 4 cm. long, 5 mm. thick; veil very slight, not forming an annulus.

Type collected on the ground in a trail at New Haven Gap, Jamaica, 5,600 ft. elevation, January 4, 1909, *W. A. & Edna L. Murrill 769*.

NEW YORK BOTANICAL GARDEN.

NOTE ON THE REPUTED POISONOUS PROPERTIES OF COPRINUS COMATUS

Louis C. C. Krieger

In Mycologia for March, 1911, Professor Dearness alludes to some recent cases of poisoning attributed by Doctor Cleghorn to *Coprinus comatus*. As this species is a favorite with mushroom-eaters, any reflection upon its character is worthy of consideration. Professor Dearness, realizing this, suggests the following explanation:

"In the process of disintegration, nocuous products undoubtedly do develop from innocent compounds, but, further, it is quite conceivable that the strength of poisonous principles may vary in the same species of mushroom or that even some alkaloid may be normally present in one set of conditions and be absent in another. On what other theory can one explain the experience reported by Dr. Cleghorn in the October number of *Good Housekeeping* (p. 442)?"

Could not a poisonous species somehow have got into the broth?

Four reasons present themselves against the view that the noted edible *Coprinus* could have caused the trouble. (1) Some mycophagists claim that deliquescence, instead of rendering it poisonous, heightens the flavor. (2) It is not apt to be eaten in the decaying condition, for it becomes repulsive to the average person by its deliquescence alone: no person with his olfactories in normal order will eat the decayed or decaying plant. (3) Except by mistake it has never before been reported as poisonous.* (4) Idiosyncrasy, in Dr. Cleghorn's cases, is out of the question, as too many individuals were similarly affected.

But if another species may be held responsible, then which?

* According to J. A. Palmer ("About Mushrooms," Boston, 1894, p. 11), Berkeley and Curtis are said to have considered it poisonous, but Berkeley ("Outlines") states it to be edible, and Curtis ("Catalogue of N. Carolina Fungi") does likewise. Indeed, its reputation as an edible fungus may be traced back to Pliny.

Coprinus comatus is not the only lawn-inhabiting agaric. There are many others, among them one with a reputation for producing just such symptoms as those described by Dr. Cleghorn. Its name is *Panaeolus campanulatus.* It is quite possible that specimens of this species were gathered and eaten along with the Shaggy Mane.

Let us compare the symptoms of Dr. Cleghorn's cases with those of a case† reported to have been caused by the *Panaeolus.* Dr. Cleghorn's account, summarized, reads as follows:

The plants eaten by the patients were found growing on a lawn. Specimens gathered there on a previous occasion had been enjoyed without deleterious effects. The last time, however, ten persons in four different families were affected as if by a poison. The effects were produced "even while the dish of stewed mushrooms was still being passed." A few individuals showed the effects later—after several hours. The symptoms were not unlike those of alcohol-intoxication. The Doctor records failure of muscular coördination, difficulty in standing, inability to walk, drowsiness, lack of control of the emotions, bloodshot eyes, enlarged pupils, and incoherent or at least inappropriate speech. Prostration was absent. Action of heart and lungs strong and regular. The vision of one patient was affected in such a way that the furniture seemed bent, pliable, and in motion. Another had a temporary, but complete, paralysis of the left arm.

In Dr. Glen's case of *Panaeolus*-poisoning, we learn that his patient, a poor man of Knightsbridge, England, collected one morning some fungi which he cooked and ate for breakfast. Eight or ten minutes after the commencement of the meal he was "suddenly seized with dimness or mist before his eyes, lightness and giddiness of his head, with a general trembling and sudden loss of power,—so much so, that he nearly fell off the chair; to this succeeded loss of recollection; he forgot where he was, and all the circumstances of his case. This temporary deprivation soon went off, and he so far rallied as to be able, though with difficulty, to get up, with the intention of coming here for assistance, a distance of about five hundred yards: he had not proceeded

† Glen, G., "A Case proving the Deleterious Effects of the *Agaricus Campanulatus,* which was mistaken for the *Agaricus Campestris,* or Champignon." London Med. & Phys. Jour. 36: 451–453. 1816.

more than half way when his memory again failed him: he lost the road, although previously perfectly acquainted with it, but was fortunately met by a friend, who with difficulty learned his state and brought him to me. . . . His countenance betrayed great anxiety; he could scarcely stand, but reeled about somewhat like a drunken man; he spoke with hesitation and reluctance; he complained of no pain except some transient twitches in his legs; he had no nausea; he suffered much from giddiness, and was greatly inclined to sleep; his pulse was slow and feeble. . . . Distressing pains in the calves of his legs," and weakness and languor the next day were also noted. An emetic was given, after which the man rapidly recovered.

Specimens of the plant responsible for this case were seen by Dr. Glen and his teacher, William Salisbury, and identified as *Agaricus campanulatus* L. (=*Panaeolus campanulatus* [L.] Fr.). Glen refers to a similar case reported by Salisbury in *The Gentleman's Magazine* for September, 1815. This reference was not looked up.

Panaeolus campanulatus, it is true, is somewhat difficult to determine, because of its great variability and its many close relatives; nevertheless, it cannot be doubted that Glen had to do with a *Panaeolus* and not with a *Coprinus,* and that is sufficient for our purposes. That the active poisonous principle was the same in both cases seems equally certain, if we may judge from symptoms; and the statements in paragraph four of this note may also be safely adduced in our attempt to clear *Coprinus comatus* of the imputation of being poisonous. Experiments with these common plants ought to settle the question beyond peradventure.

CAMBRIDGE, MASS.

NEWS AND NOTES

Dr. Robert A. Harper, professor of botany in the University of Wisconsin, has accepted the Torrey professorship of botany in Columbia University.

Professor F. E. Clements, of the University of Minnesota, accompanied by Mrs. Clements, visited the Garden on June 13 on his way to Europe.

William Russell Dudley, professor emeritus of botany at Stanford University, California, died on June 4, aged sixty-two years. Professor Dudley was called to Stanford from Cornell in 1893.

Dr. C. H. Shattuck, of the department of forestry of the University of Idaho, is planning a survey of the Kaniksu National Forest during the present summer.

In *Rhodora* 13: 57–66. 1911, Mr. Simon Davis gives some critical and interesting notes on certain rare and little-known species of fleshy fungi collected by him in 1910 in the vicinity of Stow, Massachusetts.

Dr. L. H. Pennington, assistant professor of botany in Syracuse University, spent two days at the Garden in June examining the collections of *Coprinus*.

Dr. C. H. Kauffmann has been promoted from instructor to assistant professor of botany at the University of Michigan.

Observations and notes are desired on aborted or sterile forms of the sporophores of the higher fungi.

The relation of *Ozonium* to *Coprinus* is discussed by Lutz in Bull Soc. Myc. France 27: 110–113. 1911.

Bresadola gives a critical list with notes of 79 species of Congo fungi in *Annales Mycologici* for June, 1911.

R. J. Pool has begun an illustrated series of papers on the forest fungi of Nebraska in the *Forest Club Annual.*

In the *Transactions of the British Mycological Society* (3: 179–185. 1910), A. D. Cotton continues his notes on the Clavariae of Great Britain.

An interesting contribution to our knowledge of mine fungi, by P. Spaulding, appears in the annual report of the Missouri Botanical Garden for 1910.

Monographs of the principal European species of *Hygrophorus* and *Inocybe,* by Bataille, have appeared in the memoirs of the *Societé d'Emulation du Doubs.*

Sphaeropsis tumefaciens, the cause of the lime and orange knot, was described and figured by Florence Hedges in the April number of *Phytopathology.*

Bruce Fink, in the *Ohio Naturalist* for January, lists twenty-eight species of Boletaceae collected by him during the summer of 1909 near Oxford, Ohio, and Berea, Kentucky.

The known Polyporaceae of Ohio, numbering 118 species, are listed by L. O. Overholts in the *Ohio Naturalist* for June, with descriptive notes and helpful suggestions to students and collectors.

Dr. G. P. Clinton is to be congratulated upon his discovery of the oospores of *Phytophthora infestans,* structures long sought by mycologists and declared by some to be mythical.

The various forms of crown-gall in plants have received much attention of late at the Bureau of Plant Industry in Washington. Students are referred to bulletins 183, 186, and 213 of that bureau for the results of the principal investigations.

In *Phytopathology* for June, P. Spaulding gives an account of the rusts occurring on the hemlock spruce; and also reviews three important papers by Dr. Ernst Münch, of Munich, on the relations of certain forest fungi to their hosts, including approved methods of inoculation.

The first number of the *Pomona College Journal of Economic Botany*, published quarterly by the department of biology of Pomona College, at Claremont, California, contains an article by E. O. Essig on the wither-tip disease of citrus trees caused by a species of *Colletotrichum*.

F. Theiszen has recently published through the Royal Academy of Science at Vienna a handsomely illustrated pamphlet of 38 pages on the known Polyporaceae of southern Brazil, with interesting notes and citations. The list of 146 species contains a provisional new one, *Polyporus recurvatus*, described by the author, and *Poria bicolor*, described as new by Bresadola.

The toxicity of tannin is treated rather comprehensively by Cook and Taubenhaus in a recent bulletin of the Delaware College Experiment Station. This investigation has an important bearing on problems connected with immunity from diseases caused by fungi. In this connection, it is interesting to note that the chestnut canker has selected for its own particular use a tree containing an unusually large percentage of tannin.

Pyropolyporus Calkinsii, a large ungulate species found on living trunks of live-oak in southern Florida, was collected May 5, 1911, by Dr. H. D. House on a living trunk of *Quercus nigra* at Lake Catherine, Onslow County, eastern North Carolina. The species doubtless causes heart-rot, after the manner of *P. igniarius*, hence this extension of range and the discovery of a new host is of value to the forest pathologist.

Fungi on Mosses.—*Cladosporium epibryum* Cooke & Massee was referred to in the Bryologist for May and originally described without indication of hosts. As they were all sent to Dr. Massee, I wrote to inquire about them and received the following list of mosses as host species:

1. *Ulota phyllantha* Brid.—Jaquina Bay, Ore.—T. Howell.

2. *Fabronia andina* Mitt.—Ingenio del Oro, Bolivia—H. H. Rusby.

3. *Hypnum megaptilum* Sull.—Lake Pend d'Oreille, Idaho—J. B. Leiberg.

4. *Bartramia Potosica* Mont.—Sorata, Bolivia—H. H. Rusby.

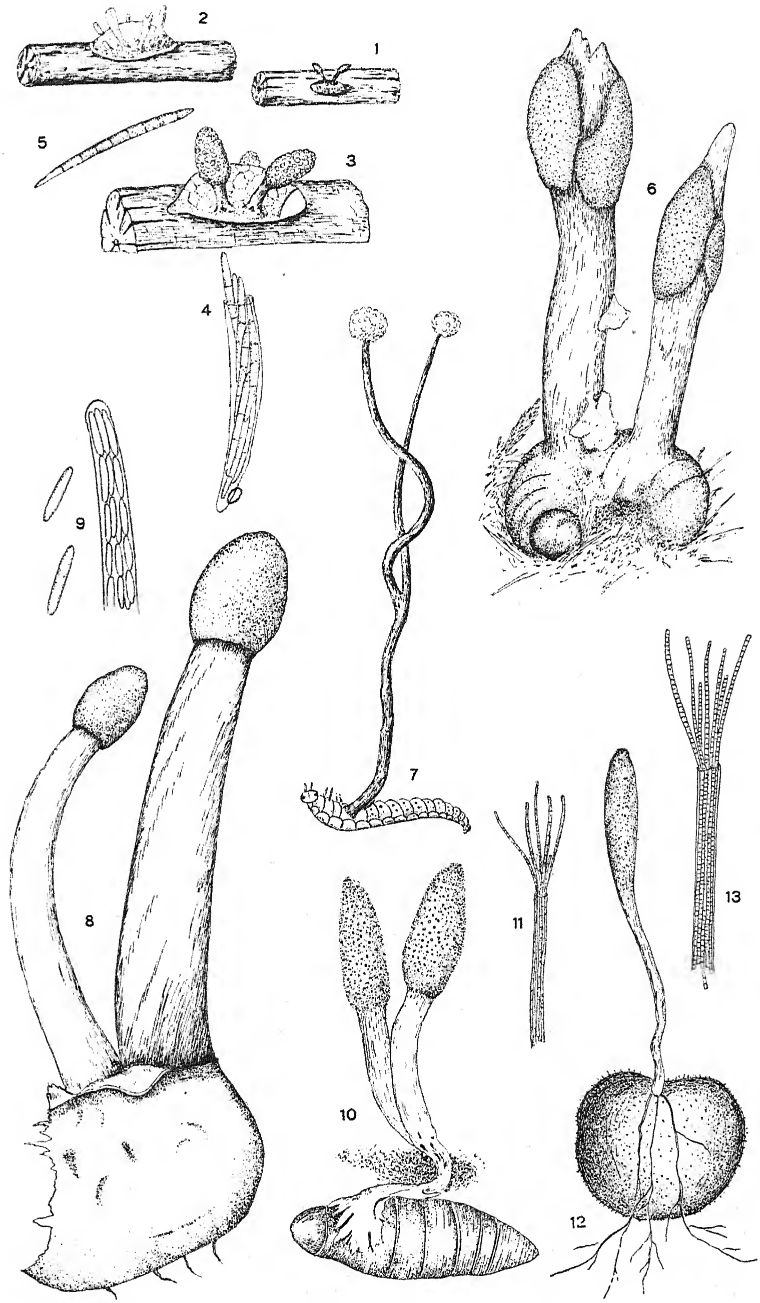
5. *Grimmia ovata* W. & M.—Canada—J. Macoun, no. 84.

6. *Grimmia Doniana* Sm.—Spokane Falls, Wash.—J. B. Leiberg, No. 110.

7. *Encalypta rhabdocarpa* Schwgr.—Lake Pend d'Oreille—J. B. Leiberg, No. 153 in publication.

8. *Bartramia pomiformis* Hedw.—Lake Pend d'Oreille—J. B. Leiberg, No. 153 in publication.

These types are at Kew and duplicates of them are at the New York Botanical Garden. The fungus occurs as black septate filaments protruding from the walls of old capsules, particularly those that have wintered over, usually species of genera that hold their capsules a long time. In the case of *Ulota phyllantha,* they occurred around the mouth of the capsule, and the teeth were so much distorted and undeveloped that it was difficult to describe the peristome in these, the first specimens of this moss to be found fruiting.—*E. G. Britton.*



CORDYCEPS

MYCOLOGIA

VOL. III SEPTEMBER, 1911 No. 5

THE HYPOCREALES OF NORTH AMERICA—IV

Tribe IV. CORDYCIPITEAE

FRED J. SEAVER

(WITH PLATES 53 AND 54, CONTAINING 26 FIGURES)

Sclerotia formed in the bodies of insects or in the stems of plants, consisting of a more or less well-developed, often compact and hard mycelial tissue; stromata developing from the sclerotia usually after a period of rest, erect and clavate or rarely pulvinate; perithecia immersed or subsuperficial (especially in aged specimens); asci cylindric; spores filiform or subfiliform, simple or many-septate, often breaking into numerous segments, hyaline.

Sclerotia formed in the bodies of insects or fruiting organs of fungi. 36. CORDYCEPS.
Sclerotia formed in the tissues of vascular plants.
  Sclerotia originating in the ovaries of plants; stromata long-stipitate. 37. SPERMOEDIA.
  Sclerotia formed in the stems or fruiting axes of plants; stromata short-stipitate or sessile. 38. BALANSIA.

36. CORDYCEPS (Fries) Link, Handb. 3: 347. 1833

Sphaeria §*Cordyceps* Fries, Syst. Myc. 2: 323. 1823.
Torrubia Lev.; Tul. Fung. Carp. 3: 5. 1865.

Stromata springing from the sclerotium or resting stage of the fungus composed usually of compact mycelial tissue within the bodies of insects or more rarely in other fungi, simple or branched,

[MYCOLOGIA for July, 1911 (3: 165–206), was issued July 27, 1911]

at first (*Isaria* stage) often delicate, producing conidia, later usually clavate, producing perithecia, which are more or less immersed or more rarely subsuperficial, collected into a globose, clavate, or agariciform head supported by a sterile stem, or sometimes surmounted by a sterile apex; asci cylindric, 8-spored; spores filiform or subfiliform, many-septate and often breaking into segments in the ascus, or more rarely simple and entire.

Type species, *Clavaria militaris* L.

- Sclerotia formed in the bodies of insects or larvae.
  - Perithecia collected into a definite, enlarged head, usually immersed.
    - Stromata large, several cm. high.
      - Occurring on larvae or pupae.
        - Head fertile to the tip.
          - Head clavate.
            - Stromata bright-orange; on pupae. — 1. *C. militaris.*
            - Stromata brownish; on larvae.
              - Spore segments short, 1.5 mic. in length. — 2. *C. palustris.*
              - Spore segments long, 3–5 mic. in length.
                - Plants stout; spore segments 4–5 mic. in length. — 3. *C. Ravenelii.*
                - Plants slender; spore segments 3.5 mic. in length. — 4. *C. acicularis.*
          - Head globose or subglobose.
            - Plants purplish. — 5. *C. insignis.*
            - Plants yellowish.
              - Spore segments 4 mic. in length. — 6. *C. flavella.*
              - Spore segments 6–8 mic. in length. — 7. *C. entomorrhiza.*
        - Head with a sterile apex.
          - Plants stout, yellowish; on white grubs. — 8. *C. herculea.*
          - Plants slender, brownish; on larvae. — 9. *C. stylophora.*
      - Occurring on adult insects (wasps). — 10. *C. sphecocephala.*
    - Stromata small, less than 1 cm. high.
      - Spores much shorter than the ascus, fusoid; on scale-insects. — 11. *C. clavulata.*
      - Spores nearly as long as the ascus, filiform; not on scale-insects.
        - Plants 3 mm. high, reddish-purple. — 12. *C. Langloisii.*
        - Plants 5–9 mm. high, yellowish. — 13. *C. armeniaca.*

Perithecia scattered, becoming subsuperficial.	
Stromata very long and slender, 5 cm. high.	14. *C. Sphingum.*
Stromata 1 cm. or less high.	
Stromata effuse or erect; perithecia becoming spathulate when dry.	15. *C. Cockerellii.*
Stromata erect; perithecia flask-shaped.	16. *C. isarioides.*
Sclerotia formed in fungi.	
Stromata agariciform.	17. *C. agariciformia.*
Stromata clavate.	18. *C. parasitica.*

1. CORDYCEPS MILITARIS (L.) Link, Handbk. 3: 347. 1833

Clavaria militaris L. Sp. Pl. 1182. 1753.

Ramaria farinosa Holmsk. Danske Vid-Selsk. Skr. II. 1: 299. 1781.

Clavaria granulosa Bull. Herb. *Fr. pl. 496, f. 1.* 1790.

Clavaria farinosa Dicks. Pl. Crypt. Brit. 2: 25. 1790.

Isaria farinosa Fries, Syst. Myc. 3: 271. 1832.

Kentrosporium militare Wallr. Beitr. Bot. 166. 1844.

Torrubia militaris Tul. Fung. Carp. 3: 6. 1865.

Sclerotia formed in the pupae of insects, compact, white; conidial stage (*Isaria*) rising from the sclerotium, consisting of a slender stalk, and a white, floccose, feather-like head; stromata at maturity consisting of a sterile stem and fertile, clavate head, usually simple but more rarely forked or branched, the whole often attaining a height of 4–5 cm., but often much shorter, bright-orange; perithecia thickly scattered or crowded, for the most part immersed with the necks protruding, or superficial (especially in weathered specimens); asci cylindric; spores filiform, nearly as long as the ascus, many-septate, breaking apart at the septa, giving rise to numerous subellipsoid segments 2–3 mic. long (*pl. 53, f. 10, 11*).

On pupae buried or partially buried in the ground.

TYPE LOCALITY: Europe.

DISTRIBUTION: Massachusetts to North Dakota and Virginia; also in Europe.

ILLUSTRATIONS: Bull. Herb. Fr. *pl. 496, f. 1;* Fl. Dan. *pl. 657, f. 1;* Sow. Engl. Fungi *pl. 60; pl. 308.*

SPECIMENS EXAMINED: Connecticut, *Earle;* Iowa, *Seaver;* Massachusetts, *Morris;* North Dakota, *Seaver* (*Isaria* stage only); New York, *Murrill, Seaver;* New Jersey, *Ellis;* Pennsylvania, *Small;* Vermont, *Burlingham;* Virginia, *Murrill.*

2. CORDYCEPS PALUSTRIS Berk & Br.; Berk. Jour. Linn. Soc. **1**: 159. 1857

Stromata 1–3 cm. high; stem 3–4 mm. thick, simple or divided into 2–4 short branchlets, even, smooth, brown; head 1–2 cm. long, thicker than the stem, cylindic-ovoid, dull brownish-purple or flesh-colored, minutely rough with the slightly protruding necks of the perithecia; asci elongate, narrowly cylindric, capitate, tapering below into a long, slender pedicel; spores arranged in a parallel fasicle, slightly curved, filiform, hyaline, becoming many septate, 100–120 × 1 mic., the segments 1.5 mic. long (*pl. 54, f. 5*).

On moist rotten logs, growing from the larvae of some coleopterous insect.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Jour. Linn. Soc. **1**: *pl. 1.*

Berkeley in his original description of this species says: "The extremely minute articulations or sporidiola, without any other character, separate this curious species which has moreover a peculiar habit."

3. CORDYCEPS RAVENELII Berk. & Curt.; Berk. Jour. Linn. Soc. **1**: 159. 1857

Stromata usually solitary, 3–8 cm. high, consisting of a sterile stem and fertile head; stem 2–5 cm. long, grooved or furrowed, brownish, becoming nearly black on drying, about 2–3 mm. in diameter; fertile head terminal or more rarely with a sterile apex or with the perithecia in patches, with bare, sterile spaces between; perithecia partially immersed, becoming almost entirely superficial, giving the fertile portions a very rough appearance, similar in color to the stem; asci very long, cylindric; spores filiform, nearly as long as the ascus, breaking into segments 4–5 mic. long (*pl. 54, f. 10*).

Springing from the larvae of coleopterous insects.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: South Carolina to Pennsylvania (and Iowa?).

EXSICCATI: Rav. Fungi Car. 4: *28*. Other specimens examined: Pennsylvania, *Everhart.*

According to Massee, this species has been collected in Texas by Wright, also in California by Harkness and is known in the western states as the "white grub fungus." While the species

seems to have been frequently collected but few specimens are available for examination.

4. CORDYCEPS ACICULARIS Rav.; Berk. Jour. Linn. Soc. 1: 158. 1857

? *Torrubia Melolonthae* Tul. Fung Carp. 3: 12. 1865.

? *Torrubia superficialis* Peck, Ann. Rep. N. Y. State Mus. 28: 70. 1857.

? *Cordyceps Melolonthae* Sacc. Michelia 1: 320. 1878.

Stem simple, elongate, slender, cylindric, often flexuous, brownish, minutely velvety at the base, smooth above, 5–8 cm. high and 1.5 mm. thick; head cylindric, about 1.5 cm. long and 3 mm. thick; perithecia blackish, large, ovoid, subsuperficial; asci subcylindric, capitate at the apex, with a short pedicel below; spores arranged in a parallel fascicle in the ascus, hyaline, filiform, straight or curved, many-septate, 130×2.5 mic.; segments 3.5 mic. long (*pl. 54, f. 9*).

On larvae buried in the ground.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: South Carolina (and New York?).

ILLUSTRATIONS: Jour. Linn. Soc. 1: *pl. 1*; Ann. Bot. 9: *pl. 2, f. 27, 28*.

EXSICCATI: Rav. Fungi Car. 4: *29* (as *Cordyceps carolinensis* Berk. & Rav.).

Berkeley says: "This species is closely allied to *C. Ravenelii* but the habit is very different. I can find no essential difference in the fruit."

Massee also regards *C. Ravenelii* as scarcely more than a variety of the present species.

Mr. Peck (l. c.) states that *T. superficialis* is "related to and intermediate between *T. Ravenelii* and *T. carolinensis*." It is not unlikely that a more extended study will show the three species to be identical.

5. CORDYCEPS INSIGNIS Cooke & Rav.; Cooke, Grevillea 12: 38. 1883

Stromata 4–6 cm. long, purple; stem 7–8 mm. thick, equal, pallid, sulcate (when dry), very minutely velvety at the base; head broadly ovoid, 1.5 cm. in length, very slightly roughened by the

necks of the slightly protruding perithecia; asci narrowly cylindric, slightly constricted below the capitate apex, narrowed below into a slender stem-like base; spores arranged in a parallel fasicle, slightly twisted, hyaline, filiform, many-septate, wavy when free, 170–180 × 15 mic., separating readily into segments in the ascus; segments 6–7 mic. long.

On larvae on the ground.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: Known only from the type locality.

6. CORDYCEPS FLAVELLA Berk. & Curt.; Berk. Jour. Linn. Soc. **10**: 375. 1868

Stromata gregarious, 3–5 springing from nearly the same point; stem 2.5–3 cm. long, about 1 mm. thick, straight or more or less curved or flexuous, even and smooth; head globose, roughened by the necks of the protruding perithecia, 2 mm. in diameter, similar in color to the stem; asci elongate, narrowly cylindric, capitate at the apex, narrowed below into a slender pedicel; spores arranged in a fascicle, filiform, many-septate, 80 × 1 mic.; component cells about 4 mic. long.

Growing from a caterpillar.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Cuba.

ILLUSTRATIONS: Ann. Bot. **9**: *pl. 2, f. 7–10.*

7. CORDYCEPS ENTOMORRHIZA (Dicks.) Link, Handbk. **3**: 347. 1833

Sphaeria entomorrhiza Dicks. Pl. Crypt. Brit. **1**: 22. 1785.
Xylaria gracilis Grev. Scot. Crypt. Fl. *pl. 86.* 1823.
Torrubia entomorrhiza Tul. Fung. Carp. **3**: 14. 1865.
Cordyceps Menesteridis Muell. & Berk.; Berk. Gard. Chron. II. **10**: 791. 1878.

Stromata consisting of a sterile stem and a subglobose fertile head; stem very slender, 2–8 cm. long, yellowish; head 5–8 × 4 mm., golden-yellow, darker with age, roughened by the prominent necks of the perithecia; perithecia ovoid, immersed or partially immersed; asci cylindric, 6.5–7 mic. thick; spores filiform, many-septate, hyaline, finally separating into segments 6–8 mic. long (*pl. 53, f. 7*).

On larvae of insects.

TYPE LOCALITY: Europe.

DISTRIBUTION: South Carolina; also in Europe, Asia, Africa, and Australia.

ILLUSTRATIONS: Dicks. Pl. Crypt. Brit. *pl. 3, f. 3;* Gard. Chron. II. **10**: 791, *f. 130;* Tul. Fung. Carp. 3: *pl. 1, f. 12–14;* Grev. Scot. Crypt. Fl. *pl. 86.*

8. CORDYCEPS HERCULEA (Schw.) Sacc. Syll. Fung. **2**: 577. 1883.

Sphaeria herculea Schw. Trans. Am. Phil. Soc. II. 4: 188. 1832.

Stromata large, attaining a height of 5–7 cm.; stem yellowish or tan-colored; head enlarged and more than 1 cm. thick, with the fertile portion often interrupted, leaving bare patches and in the specimens examined terminated by a short, obtuse apex; fertile portion roughened by the slightly prominent necks of the perithecia; asci cylindric, as long as 200–225 mic.; spores filiform, nearly as long as the ascus, many-septate, separating into joints 6–8 mic. (*pl. 53, f. 6*).

On larvae (white grubs).

TYPE LOCALITY: Salem, North Carolina.

DISTRIBUTION: Connecticut to Ohio and North Carolina.

SPECIMENS EXAMINED: Ohio, *Morgan;* Georgetown, D. C., *Billings.*

9. CORDYCEPS STYLOPHORA Berk. & Br.; Berk. Jour. Linn. Soc. **1**: 158. 1857

Stromata solitary, dull-brownish, consisting of a sterile stem and fertile head, with a long sterile apiculus, the entire plant 2–3 cm. high; stem straight or flexuous, more or less velvety, longitudinally wrinkled when dry; fertile head slightly roughened by the protruding perithecia; sterile apiculus 1 cm. or more long, asci cylindric or slightly constricted below the capitate apex; spores arranged in a fascicle, filiform, curved when free, many-septate, 125–135 × 1 mic.; segments 3.5 mic. long (*pl. 54, f. 1*).

On larvae in rotten logs.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: Michigan and South Carolina.

ILLUSTRATIONS: Jour. Linn. Soc. **1**: *pl. 1;* Ann. Bot. 9: *pl. 2, f. 40–42.*

EXSICCATI: Rav. Fungi Car. **5**: 49.

10. CORDYCEPS SPHECOCEPHALA (Klotzsch) Massee, Ann. Bot. 9: 13. 1895

Sphaeria sphecocephala Klotzsch; Berk. Lond. Jour. Bot. 2: 206. 1843.

Torrubia sphecocephala Tul. Fung. Carp. 3: 18. 1865.

Cordyceps sphecophila Berk. & Curt.; Berk. Jour. Linn. Soc. 10: 376. 1868.

Stromata 2–5 cm. high, consisting of a slender, sterile stem and a fertile head; stem pale-yellow, fibrous, often slightly twisted, 0.5–1 mm. thick; head enlarged, clavate, 5–8 mm. in length and 1.5–2 mm. in thickness, roughened by the slightly protruding necks of the perithecia; perithecia immersed, scattered, prominent; asci very long, cylindric; spores nearly as long as the ascus, breaking into fusoid segments 9–10 mic. long (*pl. 54, f. 3–4*).

Springing from the bodies of wasps.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: West Indies.

ILLUSTRATIONS: Tul. Fung. Carp. 3: *pl. 1, f. 5–9.*

SPECIMENS EXAMINED: Cuba (specimen given by *Mel. T. Cook*); also collected by *N. L. Britton* and *Percy Wilson.*

11. CORDYCEPS CLAVULATA Schw. Trans. Am. Phil. Soc. II. 4: 188. 1832

Cordyceps pistillariaeformis Berk. & Br. Ann. Mag. Nat. Hist. III. 7: 451. 1861.

Torrubia pistillariaeformis Cooke, Handbk. Brit. Fungi 771. 1871.

Torrubia clavulata Peck, Ann. Rep. N. Y. State Mus. 28: 70. 1876.

Sclerotia formed in the bodies of dead scale-insects; stromata slender, clavate, at first sterile, at maturity with an enlarged, clavate, fertile head and a slender, sterile stem, the whole 3–4 mm. high, 3–8 springing from a single sclerotium; stem slender, 1–2 mm. long, grayish or cinereous; head thicker, darker in color and strongly roughened by the protruding necks of the perithecia; asci clavate, broader near the middle, 80–100 × 8–10 mic.; spores much elongate, subfiliform, broader near the base and tapering toward either end, 7–8-septate about 50–80 mic. long, 3 mic. thick at the broadest point, hyaline (*pl. 53, f. 1–5*).

On dead scale-insects on the branches of various kinds of trees and shrubs.

TYPE LOCALITY: Bethlehem, Pennsylvania.

DISTRIBUTION: New York and New Jersey to North Dakota.

ILLUSTRATIONS: Ann. Mag. Nat. Hist. III. 7: *pl. 16, f. a–c;* Ellis & Everh. N. Am. Pyrenom. *pl. 15, f. 11–13.*

EXSICCATI: Ellis & Everh. N. Am. Fungi *2814.* Other specimens examined: Delaware, *Commons;* New York, *Peck;* North Dakota, *Seaver;* Ontario, *Dearness.*

12. CORDYCEPS LANGLOISII Ellis & Everh. N. Am. Pyrenom. 62. 1892

Stromata solitary, simple, consisting of a sterile stem and a subglobose head, the entire plant about 3 mm. high; stem 1 mm. thick, cylindric or subcompressed; head capitate, at first white, becoming reddish-purple, the upper convex surface fertile; perithecia tough-membranaceous, ovoid-conic, 100–150 × 200–300 mic., partially immersed in the stroma; asci very long, subcylindric; spores filiform, interwoven, nearly as long as the ascus, less than 0.5 mic. thick.

On dead larvae of the mason wasp.

TYPE LOCALITY: St. Martinsville, Louisiana.

DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED: Louisiana, *Langlois* (type).

13. CORDYCEPS ARMENIACA Berk. & Curt.; Berk. Jour. Linn. Soc. 1: 158. 1857

Stromata solitary or 2 or 3 springing from nearly the same point, 5–9 mm. high, consisting of a sterile stem and a fertile head; stem about 1 mm. thick, often flexuous and twisted, pale orange with a tinge of pink; head subglobose, 2–3 mm. in diameter, apricot-colored, roughened by the slightly protruding necks of the perithecia; asci long, cylindric-clavate, capitate, with a slender pedicel below; spores in a fascicle, slightly curved when free, filiform, becoming many-septate, 80–85 × 1 mic., breaking into segments 3 mic. long (*pl. 54, f. 2*).

On the excrement of birds (probably containing insect remains).

TYPE LOCALITY: South Carolina.

DISTRIBUTION: South Carolina.

ILLUSTRATIONS: Jour. Linn. Soc. 1: *pl. 1, f. 1;* Ann. Bot. 9: *pl. 2, f. 18.*

14. CORDYCEPS SPHINGUM (Schw.) Berk. & Curt.; Berk. Jour. Linn. Soc. 10: 375. 1868

Isaria Sphingum Schw. Schr. Nat. Ges. Leipzig 1: 126. 1822.
Torrubia Sphingum Tul. Fung. Carp. 3: 12. 1865.

Stromata numerous, as many as thirty often springing from a single sclerotium, very slender and thread-like, about 5 cm. high and 1 mm. in thickness, cinereous, smooth or slightly pruinose, enlarged at the base, more or less bent above; perithecia subsuperficial, subconic, 125–150 × 200–225 mic., brownish; asci elongate, cylindric; spores filiform, as long as the ascus, about 2 mic. thick (*pl. 54, f. 11*).

On dead larvae in cocoon.

TYPE LOCALITY: North Carolina.

DISTRIBUTION: New Jersey to North Carolina.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 15, f. 4–7;* Tul. Fung. Carp 3: *pl. 1, f. 1, 2.*

SPECIMENS EXAMINED: New Jersey, *Ellis*.

15. CORDYCEPS COCKERELLII (Ellis & Everh.) Ellis; Cockerell, Jour. Inst. Jamaica 1: 180. 1893

Ophionectria Cockerellii Ellis & Everh.; Ellis, Jour. Inst. Jamaica 1: 141. 1892.

Stromata effuse, spreading over and almost covering the substratum, or erect and 1–2 mm. high, yellow; perithecia occurring in cespitose rounded or irregular clusters, or scattered, subsuperficial or nestling in the substratum; individual perithecia elongate, flask-shaped or cylindric, about 1 mm. high and 0.5 mm. in diameter, reddish-brown or slightly translucent, smooth, at maturity collapsing laterally, becoming spathulate in form; asci very slender, about 1 mic. thick, breaking up into short segments (*pl. 54, f. 6–8*).

On the body of a sphingid moth.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica.

SPECIMENS EXAMINED: Bath, Jamaica, *Mrs. Swainson* (Type).

This species, which is said by Professor Cockerell to occur on a sphingid moth, is similar in perithecial and spore characters to *C. Sphingum*. The stromata in this species, however, are effuse or very short while in *C. Sphingum* they are very long and slender. This may be only a variation of the former species.

16. CORDYCEPS ISARIOIDES M. A. Curtis.; Massee, Ann. Bot. **9**: 36. 1895

Stromata gregarious, springing from a dense, white mycelium which almost entirely covers the host, 4–8 mm. high, about 1.5 mm. thick, cylindric, almost smooth, even, ochraceous (when dry), sometimes slightly curved; fertile portion 3–6 mm. long, cylindric, obtuse, axial portion not thicker than the stem; perithecia subsuperficial, large, flask-shaped, with elongate necks, ochraceous, crowded, spreading on all sides at right angles to the axis; asci narrowly cylindric slightly capitate, the base narrowed into a slender pedicel; spores filiform, continuous, flexuous when free, hyaline, 125–135 × 1.5 mic., arranged in a parallel fascicle in the ascus (*pl. 54, f. 12*).

Growing from the remains of a moth.

TYPE LOCALITY: United States.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Ann. Bot. **9**: *pl. 2, f. 36–39.*

17. CORDYCEPS AGARICIFORMIA (Bolt.) Seaver, N. Am. Fl. **3**: 53. 1910

Sphaeria agariciformia Bolt. Hist. Fung. 130. 1789.

Clavaria capitata Holmsk. Topsv. 38. 1790.

Cordyceps capitata Link, Handbk. **3**: 347. 1833.

Torrubia capitata Tul. Fung. Carp. **3**: 22. 1865.

Cordyceps canadensis Ellis. & Everh. Bull. Torrey Club **25**: 501. 1898.

Cordyceps nigriceps Peck, Bull. Torrey Club **27**: 21. 1900.

Stromata occurring singly or in clusters of several each, 3–8 cm. high, consisting of a sterile stem and an ovoid or capitate, fertile head; stem uniform in thickness or a little thicker below, fibrous, yellowish, becoming nearly black (in dried specimens), smooth; head ovoid or agariciform, about 1 cm. in diameter, reddish-brown, becoming nearly black, roughened by the slightly protruding necks of the perithecia; perithecia immersed, but prominent; asci very long, cylindric, about 15 mic. thick; spores filiform, nearly as long as the ascus, finally breaking into segments, subhyaline, fusoid or oblong-ellipsoid, with the ends rounded, 20–40 × 4–5 mic.

Parasitic on *Scleroderma* (?) and *Elaphomyces.*

TYPE LOCALITY: England.

DISTRIBUTION: Maine to Ontario and Florida.

ILLUSTRATIONS: Bolt. Hist. Fung. *pl. 130;* Tul. Fung. Carp. 3: *pl. 2, f. 10–15;* Pers. Myc. Eur. 1: *pl. 10, f. 1–3.*

EXSICCATI: Rav. Fungi Am. *387*; Rav. Fungi Car. 5: *48.* Other specimens examined: Delaware, *Commons;* Florida, *Calkins;* Maine, *Miss White;* Massachusetts, *Britton;* New Jersey, *Ellis.*

18. CORDYCEPS PARASITICA (Willd.) Seaver, N. Am. Fl. 3: 53. 1910

Clavaria parasitica Willd. Fl. Berol. 405. 1787.

Clavaria radicosa Bull. Herb. Fr. *pl. 440, f. 2.* 1789.

Sphaeria ophioglossoides Ehrh.; Pers. in Holmsk. Coryph. 144. 1797.

Sphaeria radicosa DC. Fl. Fr. 2: 283. 1805.

Cordyceps ophioglossoides Link, Handb. 3: 347. 1833.

Torrubia ophioglossoides Tul. Fung. Carp. 3: 20. 1865.

Stromata solitary or very rarely cespitose, consisting of a slender, sterile stem and an enlarged, clavate, fertile head; stem olivaceous, longitudinally striate, becoming very dark colored in dried specimens, sending out numerous branching root-like fibers which surround the substratum and extend for some distance into the surrounding soil; head clavate, much enlarged, tapering often both above and below, dark-brown, becoming nearly black on drying and roughtened by the protruding perithecia; perithecia thickly scattered, immersed or slightly protruding; asci very long, often 300 mic., and 8–10 mic. in diameter; spores filiform, nearly as long as the ascus, many-septate and often breaking into segments; segments short, a little longer than broad, about 3–4 × 2–3 mic. (*pl. 53, f. 12–13*).

On species of *Elaphomyces.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Ontario to Rhode Island and Virginia; also in Europe.

ILLUSTRATIONS: Willd. Fl. Berol. *pl. 7, f. 17;* Bull. Herb. Fr. *pl. 440, f. 2.*

SPECIMENS EXAMINED: Maine, *Harvey;* New Jersey, *Ellis;* New York, *Underwood;* Ontario, *Dearness;* Pennsylvania, *Haines, Everhart & Jefferies;* Rhode Island, *Farlow;* Virginia, *Murrill.*

DOUBTFUL SPECIES

Cordyceps albella Massee, Ann. Bot. **9**: 39. 1895. The species was based on imperfectly developed material.

Cordyceps albida Berk. & Curt.; Cooke, Grevillea **12**: 78. 1884. On crickets in Cuba. Mr. Cooke states: "Too imperfectly developed for description."

Cordyceps caloceroides Berk. & Curt.; Berk. Jour. Linn. Soc. **10**: 375. 1868.

Cordyceps Cicadae (Miq.) Massee, Ann. Bot. **9**: 38. 1895. *Isaria Cicadae* Miq. Bull. Sci. Phys. Nat. Néerl. **1838**: 85. 1838. *Torrubia Miquelii* Tul. Fung. Carp. **3**: 11. 1865. *Cordyceps Miquelii* Sacc. Michelia **1**: 320. 1878. This species, which occurs on the larvae of *Cicada*, has been reported as occurring in the United States.

Cordyceps sobolifera (Hill.) Sacc. Michelia **1**: 321. 1878. *Clavaria sobolifera* Hill.; W. Wats. Phil. Trans. **53**: 271. 1764. *Torrubia sobolifera* Tul. Fung. Carp. **3**: 10. 1865. *Sphaeria sobolifera* Berk. Lond. Jour. Bot. **2**: 207. 1843. On larvae of *Cicada*. Massee reports this species as occurring in the West Indies (*pl. 54, f. 13*).

37. SPERMOEDIA Fries, Syst. Myc. **2**: 268. 1822

Sphacelia Lév. Mem. Soc. Linn. Paris **5**: 578. 1827.
Kentrosporium Wallr. Beitr. Bot. 163. 1844.
Claviceps L. Tul. Compt. Rend. Acad. Sci. Paris **33**: 646. 1851.

Sclerotia formed in the inflorescence of various grasses and sedges, at first consisted of a soft mass of mycelium which produces conidia often accompanied with a saccharine fluid, at maturity hard, subglobose subcylindric or horn-shaped, purplish-black externally, white within; stromata developing from sclerotium after a period of rest, consisting of a sterile stem and fertile head; head subglobose, grayish, reddish-brown, or yellowish margin often partially free; perithecia flask-shaped, immersed in the stroma or with the necks slightly protruding; asci cylindric, usually capitate, 8-spored; spores filiform, nearly as long as the ascus simple, hyaline.

Type species: *Sclerotium Clavus* DC.

Little is known of the species of this genus. The following is a list of those which have been recognized for North America.

Sclerotia subcylindric, horn-shaped, or clavate.
  Sclerotia in the inflorescence of grasses.
    Sclerotia purplish-black.
      Sclerotia large, 1–2 cm. long. 1. *S. Clavus.*
      Sclerotia small, not more than 5 mm. long. 2. *S. microcephala.*
    Sclerotia cinereous. 3. *S. cinerea.*
  Sclerotia formed in the inflorescence of sedges. 4. *S. nigricans.*
Sclerotia subglobose, or conical.
  Occurring on *Paspalum.*
    Perithecia 340 × 119 mic. 5. *S. Stevensii.*
    Perithecia 816 × 225 mic. 6. *S. Rolfsii.*
  Occurring on *Tripsacum dactyloides.* 7. *S. Tripsaci.*

1. SPERMOEDIA CLAVUS (DC.) Fries, Syst. Myc. **2**: 268. 1822

Sclerotium Clavus DC. Fl. Fr. **6**: 115. 1815.
Sphaeria purpurea Fries, Syst. Myc. **2**: 325. 1823.
Sphacelia Segetum Lev. Mem. Soc. Linn. Paris **5**: 578. 1827.
Claviceps purpurea L. Tul. Ann. Sci. Nat. III. **20**: 45. 1853.

Sclerotia formed in the young ovaries of various species of grasses, at first soft and viscid, at maturity hard, purplish-black externally, whitish within, 1–2 cm. long; stromata often as many as 20–30 from a single sclerotium; stem very slender, flexuous or spirally twisted and of a dark-brownish color; head subglobose with the margin partially free, about 1–2 mm. in diameter, reddish-brown in color and roughened by the slightly protruding necks of the perithecia; perithecia entirely immersed or very slightly protruding, flask-shaped, 150–175 × 200–250 mic.; asci very long, cylindric, 100–125 × 4 mic.

In the inflorescence of rye, and of other wild and cultivated grasses.

TYPE LOCALITY: France.

DISTRIBUTION: New York to Montana and Utah, and probably throughout North America; also in Europe.

ILLUSTRATIONS: Ann. Sci. Nat. III. **20**: *pl. 1, 2, 3;* Rab. Krypt. Fl. **1**²: *f. 1–5;* E. & P. Nat. Pfl. **1**¹: *f. 247, B–L.*

EXSICCATI: Ellis & Everh. Fungi Columb. *1614, 1816, 2216, 1327;* D. Griff. W. Am. Fungi *42;* Brenckle, Fungi Dak. *4.* Other specimens examined: Colorado, *Tracy;* Kansas, *Bartholomew;* Montana, *Anderson, Kelsey;* Ohio, *Craig;* Wisconsin, *Davis, Pammel, T. A. Williams.*

2. SPERMOEDIA MICROCEPHALA (Wallr.) Seaver, N. Am. Fl. 3: 55. 1910

Kentrosporium microcephalum Wallr. Beitr. Bot. 164. 1844.
Sphaeria microcephala Wallr. Beitr. Bot. 164, as syn. 1844.
Claviceps microcephala L. Tul. Ann. Sci. Nat. III. **20**: 49. 1853

Sclerotia not exceeding 5 mm. in length; apparently differing from the preceding species only in the smaller size of the sclerotia and stromata.

In the inflorescence of various grasses; American specimens on *Calamagrostis* seem to conform with descriptions of this species.

TYPE LOCALITY: Europe.

DISTRIBUTION: North Dakota; also in Europe.

ILLUSTRATIONS: Wallr. Beitr. Bot. *pl. 3, f. 10–16;* Ann. Sci. Nat. III. **20**: *pl. 4, f. 1–11.*

EXSICCATI: Brenckle, Fungi Dak. *4.*

3. SPERMOEDIA CINEREA (D. Griff.) Seaver, N. Am. Fl. 3: 55. 1910

Claviceps cinereum D. Griff. Bull. Torrey Club **28**: 240. 1901.

Sclerotia clavate, gradually tapering upwards, straight, curved, twisted, or contorted, 1.5–3 cm. long and 1.75–2.5 mm. thick at the base, very viscid while developing, the base permanently invested by the flowering glumes of the host, dark-gray at the base, gradually fading to very light-gray or almost white at the apex; stromata erect, erumpent; stem cylindric or slightly fusiform, short, stout, almost white; head slightly flattened below and overlapping the upper end of the stalk, 2–3 mm. in diameter, light-gray, almost smooth, viscid, covered with small, darker points indicating the position of the perithecia; perithecia immersed, ovoid or subovoid, 190–225 × 60–90 mic.; asci narrowly cylindric, slightly narrowed below into a rather long, stout pedicel and slightly enlarged at the point of attachment, 135–150 × 4–5 mic.

Growing on the inflorescence of species of *Hilaria.*

TYPE LOCALITY: Cochise, Arizona.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Bull. Torrey Club **28**: 238, *f. 1–2.*

EXSICCATI: D. Griff. W. Am. Fungi *97.*

4. SPERMOEDIA NIGRICANS (Tul.) Seaver, N. Am. Fl. **3**: 55. 1910

Claviceps nigricans Tul. Ann. Sci. Nat. III. **20**: 51. 1853.

Sclerotia formed in the inflorescence of the host, 3–5 in a single spikelet, subcylindric or curved, often slightly flattened, brownish to purplish-black externally, white within, longitudinally striate; stromata not seen in American specimens.

On species of spike-rush (*Eleocharis*).

TYPE LOCALITY: Europe.

DISTRIBUTION: North Dakota and South Dakota; also in Europe.

ILLUSTRATIONS: Ann. Sci. Nat. III. **20**: *pl. 4, f. 15–22.*

EXSICCATI: D. Griff. W. Am. Fungi *10.* Other specimens examined: North Dakota, *Brenckle.*

5. **Spermoedia Stevensii** nom. nov.

? *Sclerotium Paspali* Schw. Schr. Nat. Ges. Leipzig **1**: 268. 1822.

? *Spermoedia Paspali* Fries, Syst. Myc. **2**: 268. 1822.

Claviceps Paspali Stevens & Hall, Bot. Gaz. **50**: 462. 1910.

Sclerotia yellowish to gray, globose, roughened when mature, about 3 mm. in diameter; head dull yellow; stipe short to medium, usually not more than 1 cm. long; perithecia completely covering the head, numerous, ovoid, 340 × 119 mic.; asci cylindric, 174 mic. long; spores filiform, 101 × 0.5–1 mic.

On species of *Paspalum.*

TYPE LOCALITY: North Carolina.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Bot. Gaz. **50**: 460, *f. 1,* and 461, *f. 2, 3, 5.*

6. **Spermoedia Rolfsii** (Stevens & Hall)

Claviceps Rolfsii Stevens & Hall, Bot. Gaz. **50**: 462. 1910.

Sclerotia yellowish to gray, globose, roughened when mature, about 3 mm. in diameter; head dull yellow; stipe filiform, 1–1.5 cm. long; perithecia few in head and mostly upon extreme distal portion, cylindric-ovate, 816 × 225 mic.; asci cylindric, 375 × 3 mic.; spores filiform, 260–275 × 0.5–1 mic.

On species of *Paspalum.*

TYPE LOCALITY: North Carolina.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Bot. Gaz. **50**: 461, *f. 3, 4.*

7. **Spermoedia Tripsaci** (Stevens & Hall)

Claviceps Tripsaci Stevens & Hall, Bot. Gaz. **50**: 463. 1910.

Sclerotia smooth, white to dark brown or black, nearly conical, 4–5 mm. in diameter at the base; heads gray to grayish-white; stipe thick, white to purplish-white, 1–1.5 cm. long; perithecia numerous, ellipsoid in longitudinal section, with a short beak toward the surface of the head, 390 × 153–187 mic.; asci cylindric, 145–175 × 2–3 mic.; spores filiform 130 mic. long; conidia hyaline, continuous, fusoid to lunulate, 17.4–37.7 × 2.9–8.7 mic.

On gama grass, *Tripsacum dactyloides* L.

TYPE LOCALITY: North Carolina.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Bot. Gaz. **50**: 462, *f. 6*.

DOUBTFUL SPECIES

Claviceps ? caricina D. Griff. Bull. Torrey Club **29**: 300. 1902. This is said to be *Sclerotium sulcatum* Desm. (See Mycologia **3**: 38. 1911.)

38. BALANSIA Speg. Anal. Soc. Ci. Argent. **19**: 45. 1885.

? *Ephelis Fries,* Summa Veg. Scand. 370. 1849.

? *Ophiodothis* Sacc. Syll. Fung. **2**: 652. 1883.

Dothichloe Atk. Bull. Torrey Club **21**: 223. 1894.

Sclerotia consisting of a more or less compact fungous tissue formed in the stems or inflorescence of plants; stromata arising from the sclerotium, stipitate and capitate or sessile, separated from the sclerotium by a constriction; perithecia immersed in the stroma; asci 8-spored; spores filiform, nearly as long as the ascus.

Type species: *Balansia claviceps* Speg.

1. BALANSIA HYPOXYLON (Peck) Atk. Jour. Myc. **11**: 254. 1905

? *Ephelis mexicana* Fries; Berk. Jour. Linn. Soc. **10**: 353. 1868.

Epichloe Hypoxylon Peck, Ann. Rep. N. Y. State Mus. **27**: 108. 1875.

Hypocrella Hypoxylon Sacc. Syll. Fung. **2**: 581. 1883.

? *Ephelis borealis* Ellis & Ev. Jour. Myc. **1**: 86. 1885.

Dothichloe Hypoxylon Atk. Bull. Torrey Club **21**: 223. 1894.

Sclerotia formed in the fruiting axes of the host, curved and

irregular, 1 cm. or more in length, grayish or blackish; stromata black, prominent, pulvinate or subhemispheric, 1–5 mm. in diameter, several springing from the same sclerotium, minutely roughened by the slightly protruding perithecia; perithecia immersed; asci cylindric, with a pedicel at the base, as much as 20 mic. in length; spores 1 mic. thick, at maturity breaking into segments 3–4 mic. long.

On *Danthonia spicata* (L.) Beauv., and other grasses.

TYPE LOCALITY: Sandlake, New York.

DISTRIBUTION: Maine to South Carolina, Texas and Iowa.

ILLUSTRATIONS: Jour. Myc. **11**: *pl. 81, 82, 38.*

EXSICCATI: Ellis & Everh. N. Am. Fungi *2373*. Barth. Fungi. Columb. *3027*. Other specimens examined: Connecticut, *Sheldon;* Iowa, *Buchanan;* Nova Scotia, *Dearness.*

DOUBTFUL SPECIES

Balansia discoidea P. Henn. Hedwigia Beibl. 39: 77. 1900. Doubtfully reported from North America.

DOUBTFUL GENUS

USTILAGINOIDEA Bref. Unters. Gesammt. Myk. **12**: 194. 1895.

The imperfect stage of this fungus resembles a smut and the perfect stage is said to be similar to *Spermoedia;* the genus has been placed in the Hypocreales by Lindau. *Ustilaginoidea Oryzae* (Pat.) Bref. loc cit., commonly known as the green smut of rice, is reported as occurring in Louisiana. No specimens have been seen.

NEW YORK BOTANICAL GARDEN.

EXPLANATON OF PLATE 53

Figs. 1–5. *Cordyceps clavulata* Schw. Figs. 1–3 after Berkeley and Curtis.

Fig. 1. Two plants on scale-insect, natural size.

Fig. 2. Scale-insect with a number of sterile plants.

Fig. 3. Scale-insect with mature plants.

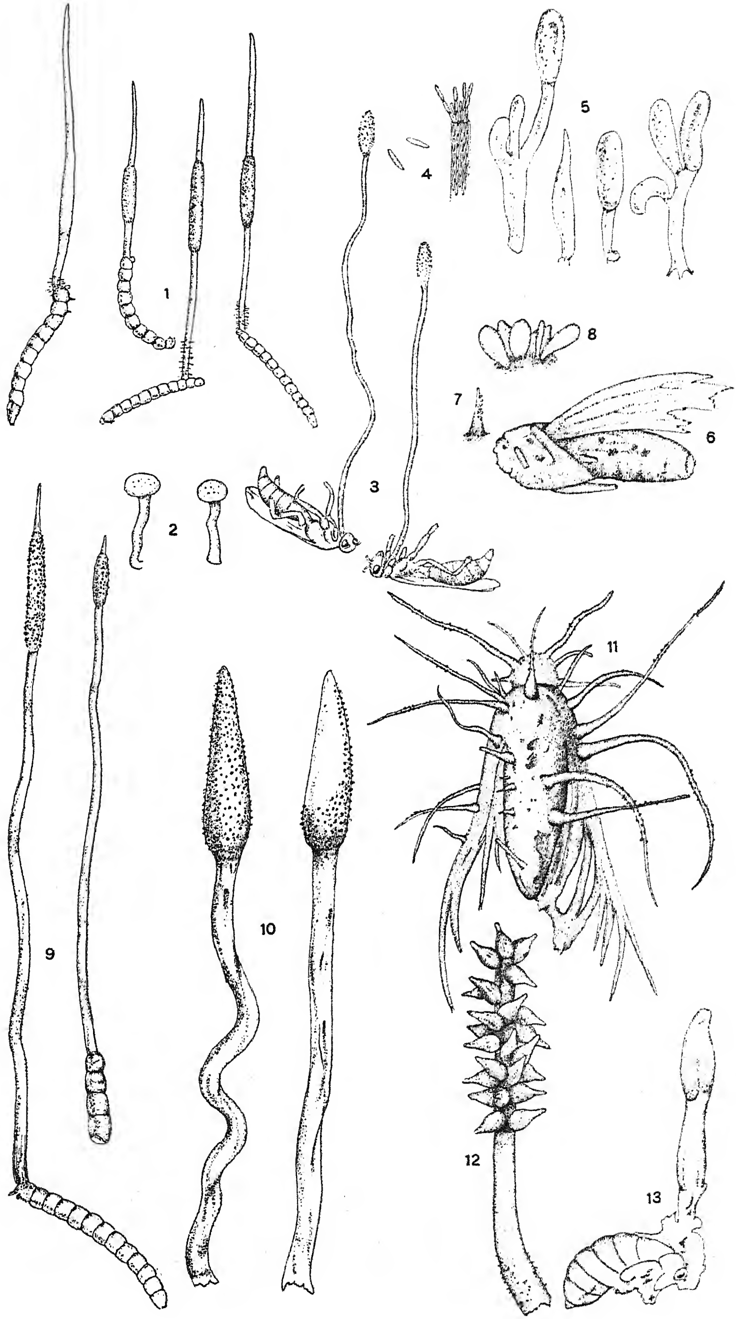
Fig. 4. Ascus with spores.

Fig. 5. One spore removed from ascus.

Fig. 6. *Cordyceps herculea* (Schw.) Sacc. Copied from photograph in herbarium of the New York Botanical Garden, about natural size.

Fig. 7. *Cordyceps entomorrhiza* (Dicks.) Link. Copied from the original drawing.

Figs. 8–9. *Cordyceps agariciformia* (Bolton) Seaver.



CORDYCEPS

Fig. 8. Two plants copied from the original drawing.

Fig. 9. Portion of ascus and spore segments.

Figs. 10–11. *Cordyceps militaris* (L.) Link.

Fig. 10. Two plants on cocoon, about natural size.

Fig. 11. Ascus and spores.

Figs. 12–13. *Cordyceps parasitica* (Willd.) Seaver. Copied from original drawing, about natural size.

EXPLANATION OF PLATE 54

Fig. 1. *Cordyceps stylophora* Berk. & Br. Copied from original drawing.

Fig. 2. *Cordyceps armeniaca* Berk. & Curt. Copied from original drawing.

Figs. 3–4. *Cordyceps sphecocephala* (Klotzsch) Massee.

Fig. 3. Two plants copied from Tulasne.

Fig. 4. Portion of ascus with spores.

Fig. 5. *Cordyceps palustris* Berk. & Br. Copied from original drawing.

Figs. 6–8. *Cordyceps Cockerellii* (Ellis & Everh.) Ellis. Drawn from original material.

Fig. 6. Remains of insect showing clusters of perithecia.

Fig. 7. Portion of erect stroma with perithecial clusters.

Fig. 8. Cluster of perithecia.

Fig. 9. *Cordyceps acicularis* Rav. Copied from original drawing.

Fig. 10. *Cordyceps Ravenelii* Berk. & Curt. Copied from original drawing.

Fig. 11. *Cordyceps Sphingum* (Schw.) Berk. Copied from Tulasne.

Fig. 12. *Cordyceps isarioides* M. A. Curtis. Copied from Massee.

Fig. 13. *Cordyceps sobolifera* (Hill.) Sacc. Copied from Tulasne.

INDEX

The following is the index to the species in the Hypocreales of North America—I (Mycologia 1: 41–76. 1909);—II (Mycologia 1: 177–207. 1909); —III (Mycologia 2: 48–92. 1910) and—IV (Mycologia 3: 207–225. 1911).

THE NATURE AND CLASSIFICATION OF LICHENS.—I. VIEWS AND ARGUMENTS OF BOTANISTS CONCERNING CLASSIFICATION*

Bruce Fink

Early in November, 1909, circular letters were sent to 75 American botanists and an equal number of foreign botanists asking for their views regarding the classification of lichens. Gathering data of this kind is an unusual method of approaching a scientific problem; but it was thought that the views of botanists might aid in the final solution of the problem. No man is able to express himself very certainly on the classification of all plants; consequently it is not surprising that certain men who write regarding the classification of many or all of the large groups of plants expressed themselves very doubtfully when asked for a statement. As was to be expected a rather small proportion of those who replied made statements which are of great value. The form of the circular letter is given below.

Botanical Laboratory, Miami University, Oxford, Ohio, U. S. A.
Nov. 8, 1909.

The undersigned wishes the following questions answered by a considerable number of leading botanists. The results of the correspondence will be given, partly in tabulated form, in a paper to be prepared as soon as possible after obtaining the necessary data. The replies will be held strictly private, the information being used without the names of those giving it. However, it may seem best to publish with the paper a list of the names of the botanists who have replied, and the writer will consider himself at liberty to use thus the names of those who make no objection to this in replying. The questions are:—

1. Have you arrived at a conclusion regarding the classification of lichens?

2. Should the lichens be maintained as a distinct class of plants, or should they be distributed among the fungi?

* Contributions from the Botanical Laboratory of Miami University.—VI.

3. What are the arguments upon which your answer to the second question is based?

It is desired that all shall *answer at least the first question,* and if this is answered affirmatively, *then at least the second also.* The third question is, of course, of special importance, and the *writer wishes as many answers to it as can be obtained,* based upon present knowledge or such investigation as can be made in short time.

Those addressed are at liberty to include in their answers matter not directly replying to the three questions if they think best. The botanists addressed have been selected with great care from Europe and America, and the answers it is hoped, besides giving the consensus of opinion, may also contribute to a solution of the problem involved.

(*Signed*) BRUCE FINK.

The letter was couched in general terms suited to those who believe that lichens should be regarded as fungi and also to those who think that these plants form a group entirely distinct from fungi. It was expected that some botanists would understand that the distribution meant was that of the text-books or of Fünfstück and Zahlbruckner in Engler and Prantl. Second letters were written to four botanists who took this view. In these letters, it was stated that the distribution intended was one which would do away with the group Lichenes. These four had stood for distribution in their first replies; but all but one of them refused to stand for distribution to the exclusion of Lichenes. Sixty-three (63) American and 45 foreign botanists replied without a second request. The number of Americans was regarded sufficient to furnish the current views and arguments, but second letters were sent to 12 Europeans in order to increase the number of foreign replies. Of these, 7 replied, making the total number of foreign replies 52.

Careful study of the preparation of those botanists who replied showed that they are not greatly influenced by the opinions held by their teachers. Being influenced by views held at large botanical centers would usually be impossible, for where replies were received from two or more men from the same center there was not an instance of accord in all particulars, and the views expressed were more often widely divergent or quite opposed.

However, botanists are influenced in their thought regarding lichens by "tradition," a fact that appears in writing about these plants, though not so certainly in the views expressed as in the faulty and ambiguous phraseology used.

Of 115 replies, 19 or about 17 per cent. favor distribution, and 14 more or about 12 per cent. think that lichens may be distributed, but for one reason or another prefer that they shall remain a distinct group. About 29 per cent. of those who replied admit the possibility of distribution, though only the 17 per cent. favor it outright. Twenty-one (21) American and 11 European replies state that lichens may or should be distributed. Twenty-three (23) American and 30 European replies state that lichens compose a group with distinct characters. Twenty-nine (29) American and 14 European replies state that lichens should be retained in a special group for practical purposes. Nine (9) Americans and 12 Europeans mention dual nature of lichens or consortism as the basis for maintaining the group Lichenes. By a series of proportions ($49:63::11:x$, etc.) the relative opinion of Americans and Europeans may be obtained, based upon what would appear in an equal number of replies from America and Europe. By such proportions, it appears that, had the number of replies been equal from the two countries, 14 Europeans and 21 Americans would have stood for distribution as desirable or at least a feasible solution. For lichens as a group with distinct characters the proportion would be 39 Europeans and 23 Americans, for the group Lichenes for convenience 17 Europeans and 29 Americans, and for expressed belief in the dual nature of lichens 15 Europeans and 9 Americans.

Botanists, it would appear from the correspondence, may be divided into three groups: those who regard classification a practical matter or an applied science; those who think that classification should, first of all, express relationship or be natural; and those who give nearly equal weight to each of these matters. Assuming that the number of replies from each country is sufficient to express the consensus for that country, it would seem from next to the last proportion above that Europeans have more regard for classification as a pure science than do

Americans and are less disposed to make convenience a prominent argument. However, it appears from another proportion that Europeans are more disposed to retain lichens as a distinct natural group than are Americans; and since this is true, there is for them not so much conflict between theoretical and practical considerations, so that one would not expect so much prominence in their replies to the matter of convenience in classification, even though they might be as strongly in favor of it as Americans. The last proportion tends to show that Europeans more commonly favor the dual-nature theory, or, an outright consortium-theory than do Americans. Three (3) Americans and 5 Europeans expressly state that they regard present knowledge insufficient to warrant distribution. On the whole, the proportions and figures seem sufficient to demonstrate that Europeans are less disposed to break with established usage regarding the systematic disposition of lichens than are Americans. This is what might be expected when it is recalled that nearly all the traditions regarding lichens have had their birth in Europe. There is just one notion regarding lichens that has been explicitly expressed in America only and that is that they should be distributed to the exclusion of the class Lichenes. Careful inquiry and thorough examination of the literature has not brought to light a single instance of such distribution by a European, while three or more Americans have distributed lichens in papers or books.

It would be impossible to state many of the views expressed in the correspondence except in the tabular presentations given below.

By inference or direct statement, 15 clearly defined reasons for maintaining lichens as a distinct group of plants are contained in the replies (see first table) while only two reasons are assigned for distributing them (see second table). Those who replied are grouped as well as could be done according to their fields of botanical work. Twenty (20) replies came from botanists who are known for work not falling in fields contained in the same vertical column in the tables. The views of these persons are given in each of two vertical columns, while those of the remaining 95 botanists are expressed only once in the tables. The figures (16–1[a]) under lichenists in the first vertical column of the

TABLE GIVING THE ARGUMENTS FOR MAINTAINING LICHENS AS A DISTINCT GROUP OF PLANTS

	Lichenists	Mycologists and Pathologists	Morphologists and Anatomists	Physiologists and Ecologists	Systematists	Misc.	Totals
Numbers addressed in each group	24	39	33	15	16	9	
1. Because a group with distinct characters	$16-1^{a}$	$10-5^{2}-1^{a}$	$9-3^{2}-1^{a}-1^{a-b}$	$4-1^{2}-1^{a-b}$	$4-1^{a}$	$4-1^{2}$	47
2. For the sake of convenience in study	$4-1^{a}$	$17-1^{1}-2^{a}-1^{b}$	$13-1^{1}-1^{4}-2^{a}$	$7-1^{1}$	0	3	44
3. Because of the dual nature of lichens	6	2	7	$3-1^{2}$	3	2	23
4. Because present knowledge is not sufficient to distribute.	1	3	4	1	1	0	10
5. Because of special methods of sexual reproduction	1	0	0	0	0	0	1
6. Because of special methods of vegetative reproduction	1	0	0	0	0	0	1
7. Because of peculiar physiological relations	0	2	1	0	0	0	3
8. Because they form a peculiar biological group	0	0	0	1^{2}	1^{a}	1	1
9. Because of the peculiar vegetative structure	2	2	0	0	0	1	5
10. Because of the large size of the group	0	1	0	0	0	0	1
11. Because of the chemical reactions of the thalli	$1-1^{1-3}$	0	0	0	0	0	1
12. For arrangement by themselves in herbaria	0	1	0	1	$2-1^{a}$	1	5
13. Because of the large literature of lichenology	0	1	0	1	0	0	2
14. Because of the distinct group of workers	0	1	0	0	0	0	1
15. Because the thecia are parasitic structures	1	0	0	0	0	0	1
Totals	33	40	34	17	10	12	146

TABLE GIVING THE ARGUMENTS FOR DISTRIBUTING LICHENS AMONG OTHER FUNGI

	Lichenists	Mycologists and Pathologists	Morphologists and Anatomists	Physiologists and Ecologists	Systematists	Misc.	Totals
Numbers addressed in each group	24	39	33	15	16	9	
a. Because lichens do not form a natural group of plants	$2-2^{1}-1^{2}$	$\left\{ \begin{array}{l} 9-1^{2-10}-1^{1}-6^{2} \\ 1^{2-14}-1^{2-12-13} \end{array} \right\}$	$8-3^{2}$	$4-1^{2}-1^{2-12-13}$	$3-1^{1-2}$	$1-1^{2-8}$	27
b. Because of the resemblance of the fruit to that of other fungi	0	1	0	1	0	0	2
c. No reason assigned	0	0	0	0	1	0	1
Totals	2	10	8	5	4	1	30

first table mean that 16 lichenists favor maintaining lichens as a natural group while one thinks that the grounds for distribution are stronger though there are reasons for maintaining the group. Figures (10–5^2) in the second vertical column of the first horizontal row mean that 10 mycologists and pathologists think that lichens should be maintained as a natural group while five think that they are probably a natural group, but should in any event be kept distinct for the sake of convenience in study. The combination 1^{a-b} in the first horizontal row and the third vertical column means that one morphologist or anatomist thinks that lichens may form a natural group, but that they more probably do not for reasons given under (a) and (b) in the table giving reasons of distributing the lichens. The figures (2–2^1–1^2) in the first vertical column of the first horizontal row of the second table mean that two lichenists believe that lichens should be distributed because not a natural group; that two others think there are arguments for this view, but that there is stronger argument for the validity of the natural group Lichenes; and that one other lichenist thinks that lichens are perhaps not a natural group but that they should be kept distinct for the sake of convenience in study. With these explanations it is believed that a study of the two tables will make the figures in the columns intelligible. The total for each horizontal row of figures gives the number of times that the view expressed in that row is favored in the replies; and the totals for each vertical column of figures indicates the number of times that all the arguments for maintenance or for distribution are favored by all the botanists belonging to the group placed in this vertical column. By way of illustration the opinion that lichens form a natural group is expressed 47 times, and reasons for maintaining these plants as a distinct group are expressed 33 times by lichenists. The vertical and the horizontal grand totals agree of course. The whole number of expressions favoring maintenance (146) is much larger than the number of botanists who stated that they favor distribution, because some of the replies give more than one reason for maintaining the group and because the views of 20 botanists are expressed in two columns for the reason stated above. The figures with exponents are not expressed in the totals and, since the first choices are ex-

pressed in figures without exponents, may be omitted in consideration of the tables by those who do not care to go into this rather difficult detail.

The total number addressed in each group of botanists indicates the policy employed in selecting botanists to whom to write. The opinions of lichenists were especially sought, even to the extent of addressing two or three amateurs in this field. So the number of lichenists addressed is somewhat above the average number in the other groups, though lichenists are few in number. After lichenists, mycologists were especially sought; and a large number of pathologists was secured because mycologists are so often also pathologists. In any consideration of classification, the views of a considerable proportion of the great number of morphologists and anatomists must be taken into account. Physiologists were addressed with a view to ascertaining what they might say about the relation of the peculiar biological condition in lichens to classification. Finally, a sufficient number of systematists, other than lichenists and mycologists, was consulted to ascertain how wide a view these persons might have regarding problems of classification in general and the classification of lichens in particular. Those who expressed no opinions or none that could be interpreted and recorded are two amateur lichenists, one mycologist, one morphologist, one anatomist, one physiologist and three systematists. Corresponding vertical columns in the two tables show that the expressions by lichenists are nearly unanimously in favor of maintaining the group Lichenes, while about one-fourth of those by other botanists are favorable to abandoning the group.

The first two rows of horizontal figures in the first table show that while the lichenists stand very largely for the integrity of the group, other botanists are much more largely in favor of maintenance for purposes of convenience than because they consider the group a natural one.

Further examination of the first table shows that besides the arguments for maintenance expressed in the first three horizontal rows of figures and already considered, the only other one noted by a considerable number of botanists is that expressed in the fourth horizontal row. Nine Europeans expressed this view (that present knowledge is not sufficient to distribute) and only

one American. It would not be in order in this paper to consider whether the views expressed after the first four horizontal rows of figures are of relatively little importance; but it may be stated here appropriately that the views expressed in the first horizontal lines in each of the two tables are, neither of them, of considerable value unless accompanied by argument or at least a brief statement of reasons why lichens do or do not form a distinct group of plants.

Although the circular letter stated that the views of botanists would not be given over their signatures, a number of correspondents replied that they did not obect to being quoted. Very probably permission of all might have been obtained to use their names with the quotations. No amount of tabulation and presentation of data could take the place of extensive quotation, but the arguments presented in the quotations may be more valuable given impersonally. The quotations were selected to express best the various arguments advanced. Twenty-one (21) of the quotations are from foreign botanists and an equal number from Americans, the character of the foreign replies being such that the number chosen for quotation is large in proportion to the number of foreign replies received. All of the foreign replies quoted save one are from European botanists. The preliminary statements of the replies are seldom quoted, and in some instances only a small portion of the reply is used. It has seemed best to give each quotation in a single paragraph and to preserve uniformity in use of italics in this paper though this often changes the form used by the one quoted. The quotations are given in the order of presentation of data in the two tables. After each quotation will be found the main division or divisions of botanical work in which its author is engaged, and the number or letter or numbers or letters under which the quotation is classified in the tables. When two possible solutions are advanced with a preference for one of them, the letter or figure representing what the one quoted regards the less satisfactory solution is followed by a minus sign. The portion followed by the minus sign is reduced, in parentheses, to the form used in the tables. So large a number of quotations is necessary, since each one expresses some important view not contained in the others, or makes some point very

apparent by brevity or clearness. It has seemed best to give the quotations without comment, leaving botanists to draw their own conclusions, except for the statistics and the summary and conclusions, which it is hoped are given without color. *The writer reserves the expression of his views, his estimate of the correspondence, and the consideration of the literature of the subject to following papers of this series.* The quotations are numbered in order that they may be referred to readily in the papers to follow in the series.

Quotation 1

To place the Lichens with the Fungi to which the parasites belong, is, in my opinion, the only scientific and logical mode of treatment. If classed separately, then a precedent is established in favor of treating all symbiotic organisms in a similar manner. Educationally, such a method is bad and certain to create confusion in the minds of students. This may be overcome in a measure by very careful treatment on the part of the teacher, but even so, there will always remain an element of doubt. This position is taken by Strasburger in his latest edition, and voices what I should conceive to be the general opinion. I do not go with him, however, in relegating such organisms to a distinct class, because the ground of expediency which he urges is not at all adequate. It is such an arrangement that constitutes, in my opinion, a very unscientific arrangement. I think it would be far better if they were placed between the Ascomycetes and the Basidiomycetes in such a manner as to exhibit their real genetic relations. This might be done by making Class-Ascomycetes, Class-Ascolichenes, Class-Basidiolichenes, Class-Basidiomycetes. The alga does not count in any such classification, as it is wholly subordinate to the parasite. *Morphologist, 1, or possibly a.*

Quotation 2

My position with reference to questions 2 and 3, as to whether lichens should be maintained as a distinct class and why, is that of Reinke, who as you are well aware maintains that they are physiologically, as well as morphologically sufficiently distinct

from both fungi and algae to be recognized as a distinct class. The fact that when either of the symbionts is removed the autonomy of the lichen ceases to exist is also a strong argument for the maintenance of a lichen class. *Ecologist, Mycologist, 1.*

Quotation 3

I think that it is expedient to preserve the lichens as a class. It seems to me, indeed, that the lichens constitute a special line of evolution; without doubt the algae and the fungi associated have each preserved the structure and the development which are characteristic of them; but the association has acquired some new characters which are all dependent upon the ordinary factors of evolution as the numerous forms and varieties that exist give evidence. The distribution of the lichens among the other fungi would result, in my opinion, in failure to recognize this essential point of the biology of these organisms. *Morphologist, 1.**

Quotation 4

With reference to your question on lichens, I consider that they should be maintained as a distinct class. I hold this view on the grounds that the fungi of the lichen have become specially modified in relation to their symbiotic mode of life. This is seen by one fact that only one or two of the lichen fungi are known in the free state. We are therefore ignorant of them in the free state, and so they cannot be studied as fungi. *Mycologist, 1.*

Quotation 5

The lichens must be treated as a special class, since the connecting links with the fungi are very few, and nearly all living species

* Je pense qu'il est utile de conserver la classe de Lichens: il me semble en effet que les Lichens constituent une ligne d'évolution spéciale: sans doute l'algue et le champignon associés ont conservé chacun la structure et le dévelopement qui leur sont propres: mais l'association a acquis de nouveaux caractères qui sont tous la dépendance des facteurs ordinaires de l'évolution comme en temoignent les nonbreuses formes et variétés qui existent. Distribuer les Lichens parmi les autres champignons aurait pour résultat, à mom avis, de méconnaitre ce point essentiel de la biologie de ces êtres.

have surely arisen from lichens and have thereby separated themselves widely from the fungi. *Lichenist, 1.**

Quotation 6

Lichens are unquestionably cryptogams. They cannot be classed as algae because they are not algae. They cannot be classed as fungi, because they are not fungi. A lichen is the mutualistic association of an alga and a fungus. This mutualism has evolved to such a degree that a distinct autonomy is established. Any attempt to separate the two mutualistically associated components destroys the autonomy. It is true that lichens on the one hand merge into the algae and on the other hand into the fungi. Nevertheless there is no such thing as a lichen unless we have an association of an alga and a fungus, an association which is to be compared to the association of living plastids in the cell. The relationship of fungus and alga in the lichen is not parasitic for both symbionts are benefited. The biological relationship has progressed so far that neither symbiont can exist alone, excepting perhaps in the very lowest types. Such a relationship of two or more originally wholly distinct organisms is designated as individualism and constitutes a distinct autonomy. There is no more excuse for classing lichens as fungi than there is for classing fungi as algae. Fungi are supposed to be a degenerate off-shoot from the class algae, are therefore nothing but modified algae and should, to follow the lead of the fungus-lichenologists, be classed as algae. Mosses are evolved from liverworts, and yet we do not class them as liverworts. Lichens are evolved from fungi and algae and have acquired such distinctive characters that we cannot class them with either fungi or algae. *Lichenist, 1, 3.*

Quotation 7

I think that the lichens cannot constitute a distinct class of cryptogams, but that in consideration of the character of the

* Die Flechten müssen als eine besondere Klasse behandelt werden, da die Anknüpfungspunkte zu den Pilzen verschwindend wenige sind und fast alle jetzt lebenden Arten sicherlich aus Flechten entstanden sind und sich dabei weit von den Pilzen entfernt haben.

organs of fluctification, the lichens are to be subordinate to the fungi. The lichens are different from the latter especially by reason of their biological characters. The less evolved fungi are perhaps saprophytes, from which are derived those which are sapro-parasites and finally those which are obligative parasites. The lichens may (?) be regarded as fungi which have realized through mutualistic symbiosis a more perfect biological condition as compared with the obligative parasitic fungi in which is illustrated only an antagonistic symbiosis. *Mycologist, Miscellaneous, 1, 3.**

Quotation 8

The lichens being, as is perfectly demonstrated, the result of a symbiosis between an alga and a fungus, must be classified as a special group, related to the Ascomycetes on one side and to the Basidiomycetes on the other. *Mycologist, 1, 3.*†

Quotation 9

Immediately after the appearance of the treatise upon the lichens, by Professor Schwendener, I accepted his opinion, that the algae and the fungi, which constitute the lichens, are quite independent beings and belong to two different classes of organisms. But, according to my opinion, the lichens are not a case of parasitism as Professor Schwendener affirms; I look upon them as the first example, known to science, of the evolution of a higher organism on account of the union (the symbiosis) of two more simple organisms. I even suppose (but this still remains to be

* Je pense que les lichenes ne peuvent pas constituer une classe distincte de cryptogames, mais que en considerations des caractères de l'appareil de la fructification les lichenes sont à subordonner aux champignons. De ces derniers les lichenes sont differents praecipue pour des caractères biologiques. Les champignons moins évolvés sont (peut-être?) des saprophytes, desquels sont derivés ceux qui sont saproparasites et ensuite les parasites obliges. Les lichenes peuvent (?) être regardés comme des champignons qui ont realisés avec la symbiose mutualistique une condition biologique plus parfaite en comparaison des champignons parasites obliges oû s'explique seulement une symbiose antagonistique.

† Les Lichens étant, comme il est parfaitement demontré, le résultat d'une symbiose entre une algue et un champignon, doivent être classifiés dans un "*groupe spécial*" annexé aux Ascomycetes d'une côté et aux Basidiomycetes de l'autre côté.

proved with certainty) that all living organisms, both plants and animals, are nothing else than colonies of more simple organisms, living in symbiosis. For this reason the lichens must be again united in a separate class, equivalent to the classes, algae and fungi. *Physiologist, 1, 3.**

Quotation 10

It appears scarcely desirable to join the lichens with the fungi. The constant occurrence of symbiosis, which these plants present, to which also they owe their very origin, and the special characters realized in their morphology, which permit, in the greater number of cases, of distinguishing at first sight a lichen from an alga or a fungus appear to me to argue in favor of their maintenance as a class. Otherwise the same lichen should be placed at once among the algae and among the fungi: and if such a solution rests upon philosophic foundations, it appears to me of practically little advantage, since it would be far, it seems to me, from simplifying the classification. *Bryologist, 1, 9.*†

Quotation 11

Since the thallus of lichens represents a symbiosis of Ascomycetes with Algae (Cyanophyceae or Chlorophyceae), it is perhaps

* Tout de suite, après l'apparition du traité sur les Lichens de M. le professeur Schwendener, j'ai accepté son opinion, que les algues et les champignons, qui constituent les Lichens, sont des êtres tout à fait indépendants et appartiennent à deux différentes classes d'organismes. Mais, selon mon opinion, les Lichens ne sont pas des cas de parasitisme, comme l'affirme M. le professeur Schwendener; je les envisage, comme le premier example, acquis par la science, de l'évolution d'un organisme supérieur, par la réunion (la symbiose) de deux organismes plus simples. Je suppose même, ce qui est certainement à prouver, que tout les êtres vivants: plantes et animaux ne sont que des colonies des organismes plus simples, vivant en symbiose. Par cette raison les Lichens doivent être de nouveau réunis dans une classe apart, équivalente aux classes des algues et des champignons.

† Il me parait peu désirable de voir réunir les Lichens aux Champignons. Les faits constans de symbiose qu'ils présentent et aux quels ils doivent leur origine même, et les caractères spéciaux réalisés par leur morphologie, et qui permettent, dans la plupart des cas, de reconnaitre à première vue un Lichen d'une Algue ou d'un Champignon, me semblent plaider en faveur de leur maintien comme classe. Autrement le même Lichen devrait être placé à la fois parmi les Algues et parmi les Champignons; et si une telle solution repose sur des bases philosophiques, elle me parait pratiquement peu avantageuse, car elle serait loin, me semble-t-il, de simplifier la classification.

logically necessary to arrange them under the fungi, or under the algae. It need only be borne in mind that the study of this interesting class of plants will be rendered difficult for many because we have hitherto considered them as a separate family. *Systematist, 1?, 3, a?.**

Quotation 12

It is not possible at present to intercalate the lichens in the fungus system in a logical, satisfactory manner, nor is it opportune. In order to distribute the lichens among the fungi in the proper places, we must know thoroughly those fungi from which the individual lichen-series arose. Though the lichenists have occupied themselves with this question for a long time, we do not yet know the fungi which first entered into the consortium. Nor is there much hope of knowing these fungi, since the fossil lichens, which could serve as guides, are wanting and the recognition of the original consortium fungi has been rendered difficult through the fact that the primitive fungus has undergone transformation in the consortium and probably, as a lichen-former, entered upon a different phylogenetic path than that taken by the primitive fungus which did not enter into the consortium. In this I fix my eyes upon the present condition of lichenology, for we cannot pass judgment on what science may yet discover. Now, one can distribute the lichens in the fungus system according to the apothecium-type, but nothing new is gained thereby, indeed the parallelism in this respect is sufficiently well known. Or one may insert the lichen-groups in the fungus-system approximately according to their points of departure: The Coniocarpei perhaps after *Stilbum,* the Graphidaceae (including *Rocella*) after *Hysterium,* the *Lecidea-Usnea* series after *Patellaria* and here also the Cyanophile for most part, etc. Thereby would come about a quite bizzare fungus-system. It would certainly seem odd to find the *Opegrapha-Rocella* series after *Hysterium* and the related fungus-genera, or the *Lecidea-Usnea* series after *Pragmopara,* etc. But

* Da der Thallus von Lichenes eine Symbiose von Ascomyceten mit Algae (Cyanophyceen oder Chlorophyceen) darstellt, so ist es wissenschaftlich wohl nötig, sie unter die Fungi, resp. Algae einzureihen. Zu bedenken ist nur, dass für viele das Studium dieser interessanten Pflanzenklasse erschwert wird, da man sie bisher als eine geschlossene Familie betrachtete.

would we thus arrive at a scientific conclusion, could such a system also be pronounced a natural one? Certainly not. It is best, considered entirely from a practical point of view, to keep the lichens together and not parcel them out on an insufficient scientific basis, thus tearing the whole lichen-kingdom into shreds. Also the consideration that the thallus development has taken a way entirely different from that of the Fungi, and the peculiar ability of the lichen thallus, not present in the fungi, to manufacture lichenic-acids may be drawn near as supports for my view. It is also self-evident that, in an independent treatment of the lichen-kingdom, the modern lichenist will not for a moment forget that the lichens are descendents of the fungi and will be especially conscious of this when he pursues phylogenetic lichen investigations. *Lichenist, 1?, 2, 4, 11.**

* Es ist heute nicht möglich in wissenschaftlich befriedigender Weise die Flechten in das Pilzsystem einzuschalten, auch ist dies nicht opportun. Um die Flechten im Pilzsystem an den richtigen Stellen unterzubringen, müssten wir genau jene Pilze kennen, von welchen die einzelnen Flechtenreihen ihren Ausgang nahmen. Trotzdem sich die Lichenologen schon seit längerem mit dieser Frage befassen, kennen wir derzeit jene Pilze, welche zuerst in das Konsortium eintreten, nicht. Es ist auch wenig Hoffnung vorhanden, diese Pilze kennen zu lernen, da uns fossile Lichenen, welche als Wegweiser deinen könnten fehlen, und die Erkenntnis der primären Konsortiumurpilze dadurch erschwert wird, dass auch der ursprüngliche Pilz im Konsortium Veränderung erlitt und entwicklungsgeschichtlich als Flechtenbildner wahrscheinlich andere Wege einschlug, als der nicht in das Konsortium getretene primäre Pilz. Hiebei fasse ich nur den dermaligen Stand der Lichenologie ins Auge, denn darüber, was die Wissenschaft noch bringen wird, steht uns kein Urteil zu. Nun könnte man ja, entsprechend dem Apotheziumtypus die Flechten in Pilzsystem einreihen, doch damit ist nichts Neues gewonnen, ja der Parallelismus in dieser Beziehung ist hinlänglich bekannt. Oder man könnte die Flechtenreihen approximativ nach den Ausgangspunkten derselben ins Pilzsystem einschalten; die Coniocarpei etwa nach *Stilbum*, die Graphidaceae (bis inclusive *Rocella!*) hinter *Hysterium*, den Stamm *Lecidea-Usnea* hinter einer *Patellaria* und hier zugleich auch die Cyanophili zum grössten Teil u. s. w. Dadurch käme ein recht bizzares Pilzsystem zustande; es würde gewiss verblüffend wirke, hinter *Hysterium* und die anschliessende Pilzgattung die Reihe Opegrapha—Rocella anzutreffen, oder hinter *Pragmopara* die Reihe *Lecidea—Usnea* u. s. w. Wären wir aber dadurch zu einer wissenschaftlichen Erkenntnis gelangt, würde ein derartiges System auch als natürlich angesprochen werden können? Gewiss nicht. Es ist am besten—von praktischen Gründen gänzlich abgesehen—die Flechten beisammen zu lassen und sie nicht auf wissenschaftlich unzureichender Grundlege zu gestückeln, das ganze Flechtenreich in Fetzen zu reissen. Auch die Erwägung, dass die Thallusentwickelung einen von den Pilzen ganz unabhängigen Weg eingaschlagen hat, die eigenartige, bei den

Quotation 13

I believe that the lichens should be maintained as a distinct class under the fungi, and co-ordinate with the Ascomycetes. The argument for distributing the lichens among the other fungi is based on the close similarity between the lower forms of lichens and certain fungi, it being pointed out that in these forms, algae are present in small numbers or only loosely associated with the fungi. It seems to me, however, that in considering the nature of lichens it is fair to take the typical members of the group, these low forms referred to showing the origin of the group, but not showing its characteristic features. We do not call the Green or Brown Algae "animals" just because the lower members of these groups are scarcely separable from *Flagellata*. Comparing, then, the more typical Lichen-fungi with the true Fungi, there are striking and important differences. (A) The true fungi have been developed from the Algae by adapting themselves to new modes of nutrition and to subaerial habitats. Throughout the group, however, the vegetative body remains simple, the chief differentiation being in the direction of massive fruiting-bodies for the better protection and dissemination of the spores. The evolution of the Lichen-fungi has been in the direction of a massive vegetative body, often highly specialized, and with peculiar methods of vegetative multiplication (soredia). The lichen-thallus is a development of the vegetative body wholly without parallel among the true fungi. There are certain Ascomycetes which are parasitic on Laminarias, but these have the usual simple, filamentous mycelium. It is in the development of the thallus that the parasitism of the lichen-fungi differs. Ephebe, which is exceptional among the lichens, most closely approaches the true parasitic fungi. (B) It may be objected that to base a class on differences in vegetative structure is contrary to the usual principles of classification. But the chief distinctions between the Class:

Pilzen nicht wiederkehrende, Eigenschaft des Flechtenlagers, Flechtensäuren zu bilden, kann als Stütze meiner Auffassung herangezogen werden. Es ist selbstredend, daas auch bei einer selbständigen Behandlung des Flechtenreichs der moderne Lichenologe keinen Moment darauf vergessen wird, dass die Lichenen Descendenten der Pilze sind und wird sich dessen insbesondere dann bewusst sein, wenn er phylogenetische Flechtensudien betreibt.

Hepaticae and the Class: Musci, lie in the vegetative structure, the methods of reproduction being essentially the same in the two groups. (C) Furthermore, it is probable (from the researches of Baur and others) that the processes preceding the formation of apothecia in the lichens, while similar in some respects to the conditions shown by De Bary, and more recently by Blackman and his students, in the Ascomycetes, also differ in important details, notably in the great development of the trichogyne, and the suggested functioning of the spermatia as male cells. This subject, however, of the nature of the contents of the spermagonia (or pycnidia) is too obscure to furnish the basis for argument on either side. (D) According to the views here advanced the so-called "Basidiolichens" should not be considered as true lichens, since in these forms the algal cells are associated with the fruiting-body, and not with the mycelium to form a thallus as in the typical lichens. To sum up: The lichens are undoubtedly fungi associated, probably parasitically, with algae. While being classified under the Series: Fungi, they should be placed in a class by themselves, on account of the entire group being characterized by a specialized vegetative body, the thallus. *Lichenist, 1, 5?, 6, 9.*

Quotation 14

It is almost universally conceded that the spermogones, pycnides, etc., of the lichen thallus are parasitic fungi. If this be true, there is every reason to believe that the so-called fructification (Apothecia) of lichens are likewise parasitical bodies. Between the thecia of lichens and those of fungi there is said to be an analogy or similarity. And so far as I know this is the only ground for assumed relationship. The similarity ends there. What then may we call the remainder of the highly differenced thing dubbed as Lichen, when externally and internally it is different from any known vegetable growth? I have long believed that the thalli of the higher lichens are invariably reproduced vegetatively, never from the spores of the so-called fruit. With regard to the latter, I have at the same time held the opinion that if these spores reproduced anything at all, it in all probability would be merely other thecial bodies with a likeness to the parent. A

curious circumstance of year before last may be cited here. *Parmelia rudecta* is often found fertile here, *P. saxatilis* less commonly, and *P. crinita pilosella* almost never. On one tree trunk I found the first named uppermost, the second in its form *furfuracea*. Just below, and at the base of the tree, the last, all fertile. Now it will take more than mere argument to convince me that the apothecia or rather thecia of *P. crinita pilosella* were not adventitious with one or the other of the superior plants responsible. The so-called thecia of *Coenogonium* belong to *Gyalecta,* and I know that the thecia of *Theloschistes parietius* and *Placodium elegans* are conspecific. The hyphema of the lichen thallus may resemble those of the mycelium of fungi, may be fungoid, but the thallus is too much modified structurally and morphologically for the parallel to be more than mere resemblance. In the lower lichen together with a conspecific thecial character, there may be a conspecific thalline one. I have found *Lecanora subfusca glabra, Conotrema urceolatum* and *Pertusaria velata* growing on the same thallus, and right here is where some investigator can add lustre to his crown of glory. Let him investigate the thalli of the lower lichens and he will find ample proof of the parasitism of the lichen thecia. *Lichenist, 1, 15.*

Quotation 15

I send you the reply to the question that you have asked concerning the lichens. For me the affirmative answer has not the shadow of a doubt, and it is absolutely impossible that those who have worked up the anatomy of certain of the cryptogams should not be of my opinion. Most of those who desire to unite the lichens with the fungi base their view upon the similarity of fructification in certain species of the two classes; but the botanists have only considered one side of the question and this not the principal one. Indeed, a plant must exist before producing fruit and not all necessarily fructify at all. It is, therefore, the means of existence of the lichens, that is to say its thallus, that must be examined first of all. It is in the thallus, moreover, that the consortium, composed of the two elements is found. Therefore, the structure of the thallus, and especially that of its cortex, is entirely different from that of the fungi. The lichens

form a class absolutely distinct from other cryptogams. They result from the association of a fungus and an alga and in consequence they are complex organisms, which by reason of the two elements which compose them, stand entirely distinct. This is so true that if one attempt, in any species of lichen whatever, to identify either the hyphae or the gonidia with the species which appear to be related, either among the fungi or among the algae, one will not usually succeed; a most doubtful placing does not extend beyond the genus, moreover, if one examines the manner in which this consortium operates, one notices that the same hyphae always live together with the same gonidia: no exception to this rule has ever been noted. Therefore the lichen exists on the condition that the spore in sending out its filaments, encounters the alga which was in existance in the thallus which has produced it. This organization of the lichen proves superabundantly that it cannot belong either to the domain of the Fungi, nor to that of the Algae. Finally, the anatomy of the lichens separate them entirely from the Fungi. *Lichenist, 1, 3, 9.**

* Je vous envoie la reponse à la question que vous avez bien voulu me poser au sujet des lichens. Pour moi la réponse affirmative ne fait pas l'ombre d'un doute et il est absolument impossible que ceux qui ont fait l'anatomie de quelques unes de ces cryptogames ne soient pas de mon avis. La plupart de ceux qui veulent les rattacher aux champignons s'appuient sur l'analogie de la fructification chez certaines espèces des deux classes; mais les botanistes n'envisagent qu'un côté de la question et celui qui n'est pas le principal. En effet une plante doit exister avant de fructifier et toutes ne fructifient pas necessairement. Ce sont donc les moyens d'existence du Lichen, c'est-à-dire son thalle, qu'il faut examiner avant tout. C'est dans celui-ci du reste que se rencontrent le consortium des deux éléments constitutifs. Eh bien: la structure de ce thalle et particulièrement de son cortex est tout à fait différente de celle des champignons. Les lichens forment une classe absolument distincte des autres Cryptogames. Ils proviennent de l'association d'un Champignon et d'une Algue et par conséquent ils sont des êtres complexes, les quels en raison des deux éléments qui les composent demeurent entièrement distincts. Cela est si vrai que si l'on tente dans une espèce quelconque de Lichen, d'identifier, soit les hyphes, soit les gonidies avec les espèces qui paraissent leurs voisines soit parmi les Champignons, soit parmi les Algues, on n'y parviendra genéralement pas; l'appréciation le plus souvent ne dépassera pas le genre. De plus si on examine la façon dont s'opère ce consortium, on remarque que toujours les mêmes hyphes vivent avec les mêmes gonidies: aucune exception à cette règle n'a jamais été signalée. Donc le Lichen n'existe qu'à la condition que la spore en emettant ses filaments, rencontre l'Algue qui existait dans le thalle qui l'a produite. Cette organisation du Lichen prouve surabondamment qu'il ne peut appartenir ni à la classe des Champignons, ni à celle des Algues. Enfin l'anatomie des Lichens les sépare complètement des Champignons.

Quotation 16

From a point of historical continuity I presume they might better be kept as a distinct class. I am not, however, familiar enough with the intimate histology and the life histories of the group to say whether or not from the morphological standpoint they ought to be kept distinct or distributed among the fungi. If they are to be broken up and distributed among the fungi, the distribution should only be made after positive evidence has been obtained in regard to the exact relationships between each lichen genus or family and the fungus genus or family under which it is placed. If a new distribution amongst the fungi is made it should at least tend toward a permanent natural classification and should not be a new classification of convenience. *Mycologist, Pathologist, 1, 4.*

Quotation 17

According to my judgment, it is practical and convenient to maintain the lichens as a distinct class; meanwhile it must be a task of lichen investigation to discover the relation of the individual lichen fungi to the isolated living fungi and to assign the place of each of the former among the latter. *Morphologist. Mycologist, 2, 4.**

Quotation 18

It seems to me that from every point of view the lichens should be kept as a distinct group of plants. To distribute them among the fungi would cause endless confusion. The group is so large and the forms so highly differentiated that merely as a matter of practice they must always have their own following of botanists, who, if they devote themselves to the lichens, can have little time for other specialization. Systems of classification must first and foremost have a basis of common sense, since they are at bottom devices for convenience, and no theoretical arrange-

* Meiner Meinung nach ist es practisch und bequem, die Flechten als besondere Klasse beizubehalten; indessen müsste es eine Aufgabe der Flechtenforschung sein, die Beziehung der einzelnen Flechtenpilze zu den isoliert lebenen Pilzen zu erforschen und jedem der erstgenannten seinen Platz unter den letzgenannten anzuweisen.

ment will ever establish itself in which complexity is offered in place of simplicity. I can illustrate this point with what seems to me an essentially parallel case to the one in point. Certain of the bacteria are so close to the blue green algae as to be very near relatives, perhaps even species of the same genus, but as a matter of practice the science of bacteriology is not likely to confuse its system of classification of the organisms with which it deals by combining the Schizomycetes with the Cyanophyceae. *Morphologist, Cryptogamist, 1–, 2 (1²).*

Quotation 19

If we compare lichens with parasites growing on other plants, such, for instance, as the mistletoe on the apple-tree, or *Peronospora* on some herbaceous plant, it then, of course, is absurd to think of naming the ensemble of host and parasite as one thing, but here there is a question only of simple parasitism. I do not see why we might not with more justice liken the symbiotic forms called lichens to the mixed rocks, where as in granite we have, for instance, varying proportions of quartz, mica and feldspar, and although we know perfectly well that the compound which we call granite is composed of these elements, and we can see these elements in it, we still speak of the mass as granite, and so of puddingstone and other rocks. I do not see that any harm would result from continuing the old method of designating lichens under the lichen name with such modifications as would express the new knowledge. Why would it not be possible to write after the binominal Latin name of the Lichen the Latin name of the fungus involved, followed by the Latin name of the alga, the two being separated by a plus sign and the whole enclosed by a parenthesis. .... (.......... + ...). This would show at a glance what the ordinary student wants, namely, some name for that particular looking compound which he finds on rocks, trees, etc., and at the same time would furnish the scientific man all the data known respecting the two organisms forming the union. In case the fungus is known but the alga uncertain, or the alga known and the fungus uncertain, it would be very easy to introduce general statements within the parenthesis, *e. g.,*

fungus ? plus so and so. In other cases where neither of the symbionts is known definitely that sort of a statement could go into the parenthesis. *Mycologist, Pathologist, 1 ?, 3.*

Quotation 20

If I were classifying lichens for systematic purposes, I should keep them all together as a class as a matter of convenience. If I were making a scientific classification in which I was endeavoring to show actual sequences and relationships, I should distribute them in their natural places near their related fungus forms. Since, however, the lichens have always been studied by themselves and are likely to be for a long time, I see no advantage in trying to make things "natural" in any classification, by making them inconvenient. *Mycologist, 2, a–* (1^2).

Quotation 21

I believe it proper, whether from a scientific or a practical point of view, to keep the fungi and the lichens separate in two classes, the one beside the other. For me the character of the symbiosis with the algae and the peculiar character of the thallus is sufficient to separate the two classes. *Mycologist, 1, 2, 9.**

Quotation 22

From a purely theoretical point of view, a distribution of the lichens among the various fungus orders with which they are related is really a matter of course, there being satisfactory examples to show that lower lichens are in a certain intermediate condition so that one may in various ways fix the bridges between undoubted fungus genera and the lichens related to them. Nevertheless, it seems to me more expedient for the present to keep the lichens as distinct as possible, even for systematic consideration, since their dependence upon the symbiotic algae—especially in the groups that have complicated thallus structure—continually forces

* Je crois convenable, soit au point de vue scientifique que practique de tenir séparés en deux classes distinctes les fungi et les Lichenes, en les placant tout à fait à coté les uns des autres. Pour moi le caractère de la symbiose avec les algues et d'un thalle tout à fait particulier est suffisant pour séparer les deux classes.

the systematist to a consideration of their physiological isolation. One must of course continually keep in mind that in spite of their well-known polyphyletic origin, the connection of the lower lichens with the fungi is to be further studied as far as possible and that in the study of the respective fungus groups, the consideration of their connection with the related lichens must never be lost from sight. But the relationships are, also, already sufficiently well expressed in just this way. Then, for the rest, the isolation recommends itself because a certain division of labor exists at present, such that a special mycological and lichenological knowledge is seldom found in the same person. Therefore both departments may well, as heretofore, remain distinct and side by side, Lichenology of course always in close relationship with the results of mycological research. . . . Finally, clearness is more important for the systematist than a too puristic system, especially where, as here, he works in a special field. Moreover, in many instances, the conception of phylogenetic relations still vacillates strongly. *Lichenist, 2, a– (1²)*.*

* Vom rein theoretischen Standpuncte aus, ist eine Aufteilung der Flechten in die verschiedenen Pilzordnungen, mit denen sie verwandt sind, eigentlich selbstverständlich, giebt es doch genügend Beispiele dafür, dass niedere Flechten auf einem gewissen intermediären Stadium verharren, sodass man verschiedentlich die Brücken zwischen gewissen Pilzgattungen und den ihnen verwandten Flechten festzustellen vermag. Dennoch will es mir practischer erscheinen, auch gegenwärtig noch die Flechten, selbst bei systematischer Behandlung, möglichst gesondert zu halten, denn ihre Abhängigkeit von den symbiotischen Algen—zumal bei den Gruppen mit komplicierterem Thallusaufbau—zwingt auch den Systematiker forwährend zur Berücksichtigung dieser ihrer physiologischen Sonderung. Man muss sich dabei natürlich stets ihres sicher nachgewiesenen polyphyletischen Ursprunges bewusst bleiben, ja, es ist selbstverständlich der Zusammenhang der niederen Flechten mit dem Pilzen weiter möglichst eingehend zu prüfen und es dürfen bei den betreffenden Pilzgruppen die Hinweise auf die sich an sie anschliessenden Flechten niemals fehlen. Damit ist aber auch die Zusammengehörigkeit bereits genügend ausgedrückt. Denn im Ubrigen empfiehlt sich die Sonderung schon deshalb, weil bis auf den heutigen Tag eine gewisse Arbeitsteilung unter den Forschern in sofern besteht, als mykologische und lichenologische Specialkenntnisse sich nur selten in einer Person vereinigt finden. So können beide Gebiete auch nach wie vor gesondert neben einander bestehen, näturlich die Lichenologie stets in engster Verbindung mit den Resultaten mycologischer Forschung. . . . Schliesslich ist doch Uebersichtlichkeit für den Systematiker, besonders wo es sich wie hier, um ein Specialgebiet handelt, wichtiger als eine allzu puristische Systematik, ausserdem schwanken ja auch in vielen Fällen die Auffassungen über manche phylogenetischen Zusammenhänge noch sehr stark.

Quotation 23

It seems to me most practical to classify the Ascolichenes as a group of the Ascomycetes and the Basidiolichenes, as a group of the Basidiomycetes. A further distribution of the Ascolichenes among the families and genera of the Ascomycetes I regard impracticable for the present. The present classification of the Ascomycetes is quite antiquated and artificial, and surely does not express the natural relationships. Accurate comparative developmental investigations of very many Ascomycetes must first give the material for a new grouping and a fairly natural system of the Ascomycetes. Perhaps it will then also be possible to distribute the lichens among these, but it is also possible—and it seems to me even probable—that it will appear that the families now grouped together as Ascolichenes constitute a reasonably distinct, special family—leaving out of consideration their physiological behavior, symbiosis, etc. *Morphologist, 2, 4.**

Quotation 24

The individual lichen plant is a specific organism, as capable of specific recognition and description as any other plant species. It is entirely different in structure and physiology from either component alone (*e. g.,* cortical layers, etc.), and often one component is considered incapable of living without the other. Lichens have developed specific and specialized reproductive bodies (soredia). Lichens exhibit many degrees of union and mutual dependence of the components, forming phylogenetic series. Lichens form a

* Mir scheint es am zweckmässigten,die Ascolichenes als eine Gruppe der Ascomyceten und die Basidiolichenes als eine Gruppe der Basidiomyceten aufzuführen. Eine weitere Aufteilung der Ascolichenes unter die Familien und Gattungen der Ascomyceten halte ich zur Zeit noch für nicht möglich. Die heutige Systematik der Ascomyceten ist eine durchaus veraltete und künstliche, entspricht sicher nicht der natürlichen Verwandtschaft. Genaue, vergleichend enwicklungsgeschlichtliche Untersuchungen sehr vieler Ascomyceten müssen erst das Material für eine neue Gruppierung und ein einigermassen natürliches System der Ascomyceten ergeben. Vielleicht ist es dann möglich, auch die Ascolichenes mit aufzuteilen, aber es ist auch möglich—und mir sogar sehr wahrscheinlich—dass sich ergeben wird, dass die heute als Ascolichenes zusammengefassten Familien eine ziemlich geschlossene eigene Familie der Ascomyceten bilden—ganz abgesehen von ihrem physiologischen Verhalten, Symbiose, u. dgl.

group with as distinct ordinal and family characters as those found in any other groups of plants. Classification is a means to an end. The most useful ends of classification are: (1) Identification of species described and studied by various persons, (2) association of morphological and physiological ideas concerning various plants into useful units of thought. These ends are most helpfully met for me, by maintaining lichens as an independent group. I take it that the real crux lies in my last point. There is of course no possible phylogenetic relation between Ascolichenes and Basidiolichenes. It becomes finally a choice between the convenience to the student of emphasizing such *difference in origin* or of emphasizing the *many points of resemblance* between all lichens. I prefer the latter. *Morphologist, 1–, 2* (1^2).

Quotation 25

Had we used strict logic, according to the usual procedure elsewhere in systematic Botany, each independent component of the lichen thallus—algae as well as fungi—would have its allotted place near those organisms with which it appears most closely related. But the needs of the lichen-taxonomist are not satisfied in the least by this arrangement. Also the breaking down of this biological group would be very unfavorable for those investigators who study this interesting group, the lichens, in their anatomical, physiological or geographical relations. Because of these considerations I answer your questions as follows: (1) Yes. (2) The lichens should be maintained as a special, biological class. To complete the fungus-system, the genera of the lichen-fungi should, at least, be mentioned among the orders of the fungi. *Biologist, 2, 8, a–* (1^{2-8}).*

* Verfährt man streng logisch, nach den sonst in der Systematik übligen Gepflogenheiten, so hat selbstverständlich jede Komponente des Flechtenthallus —Algae wie Pilz—ihren im System anzuweisenden Platz neben denjenigen Organismen, mit denen sie am nächsten verwandt erscheint. Damit ist aber den Bedürfnisen des Flechtensystematikers nicht im geringsten genügt. Auch für die jenigen Forscher, welche die so interessante Gruppe der Flechten in anatomischer, physiologischer, geographischer Beziehung studieren, wäre die Auflösung dieser biologischen Gruppe sehr unvorteilhaft. Auf Grund dieser Erwägungen beantwortete ich Ihre Fragen folgendermassen: (1) Ja. (2) Die Flechten sind als besondere biologische Klasse aufrecht zu erhalten. Zur vervollständigung des Pilzsystems sind die Gattungen der Flechtenpilze bei den Ordnungen der Pilze wenigstens zu erwähnen.

Quotation 26

Theoretically, and as a matter of pure science, I have no doubt that lichens are fungi. Classification, however, is not a pure science but an applied science. I understand your question to refer to classification for use in systematic work. Up to the present time our systematic knowledge of lichens, with the exception noted below, has come from lichenologists proper. Of course some men have written on both fungi and lichens (*e. g.*, Nylander, who wrote also on Pezizae), but they in the one case, wrote as mycologists; in the other, as lichenologists. In all probability for an indefinite time to come descriptive work in lichens will continue to be in the hands of those who are lichenologists in the strict sense. The mere fact that the gymnocarpic lichens, for instance, are really Discomycetes is no reason why their study should be turned over to those who are specialists in the discomycetous fungi. Practically it is better that we should still continue to regard lichens as a distinct group to be studied by specialists as far as their systematic study is concerned. It is, however, true that lichens and fungi overlap in some cases. Take *Calicium* for instance. Some have gonidia and some do not, therefore, some are lichens and some are fungi. My opinion is that, considering the similar structure of the fruit, whether gonidia are present of not, genera like *Calicium* should be treated as a whole and not split up into fungi and lichens and treated fragmentally. One notices how in Engler and Prantl some genera have been overlooked for the reason that in the part on lichens they were assumed to be fungi and in that on fungi, to be lichens. There are therefore, a few genera with regard to which it may be doubtful whether they should be treated exclusively by lichenologists or not, but that does not affect materially the general question. *Mycologist, 2, 14, a–* (*1*$^{2-14}$).

Quotation 27

While I am ready to admit that theoretically the lichens should be included perhaps among the fungi, practically I think they should be regarded as a separate group. The lichens make up such a large group which is so different from all groups of fungi

that they are usually and most conveniently studied by themselves; a study which is certainly sufficient for the life work of any one man. The lichens always appealed to me as being a group comparable systematically to the diatoms or bacteria. That is to say for all practical purposes groups standing off by themselves and best considered by themselves, whatever views one may hold regarding their theoretical relationships. *Mycologist, 2, 10, a–* (1^{2-10}).

Quotation 28

It is practical to treat the lichens as a special class and besides to place under the fungi all those fungi which appear combined with algae as lichens, but also appear without algae as free fungi. We do the same with the algae. If any one wishes to place the lichens under the fungi, there is nothing to say against it. The question is not a scientific one, but a purely practical one. The main point is to learn to know the lichens better and better in all respects. How one wishes to classify them afterwards is a tolerably indifferent matter. It is practical to retain a special division as lichens because we already have so large a lichen literature and such large lichen herbaria, and because most lichens are clearly characterized as such. *Mycologist, Physiologist, 2, 12, 13, a–* ($1^{2-12-13}$).*

Quotation 29

From what I know of the Lichens I should be strongly inclined to regard them as having their proper taxonomic position among the Fungi, and they ought to be distributed according to the relationships indicated by the fungal characters. It seems to

* Es ist praktisch, die Lichenen als besondere Classe zu behandeln, und ausserdem alle jene Pilze, welche mit Algen verbunden als Flechten, aber auch ohne Algen als freie Pilze vorkommen, ausserdem unter den Pilzen aufzuzählen. Mit den Algen macht man es ja auch so. Wenn Jemand die Lichenen unter den Pilzen aufzählen will, so ist auch nichts dagegen zu sagen. Die Frage ist keine wissenschaftliche, sondern eine rein practische. Die Hauptsache ist, die lichenen in jeder Hinsicht immer besser kennen zu lernen. Wie man sie nachher klassificiren will, ist ziemlich gleichgültig. Practisch ist die Beibehaltung einer besonderen Lichenen-Abteilung, weil es eine so grosse Lichenen-literatur und grosse Lichenen-Herbarien bereits giebt, und weil die meisten Lichenen als solche deutlich characterisiert sind.

me that the term lichen rightly understood is more an ecological expression than it is morphological or taxonomic. A fungus and an alga form a peculiar type of association, and we call that association a lichen. Originally the term may have had some morphological foundation, but it has certainly now become so extended that its only significance is that of a special type of association. It is true that the association is often of an exceedingly intimate character involving morphological changes of a fundamental nature, but this is true of associations everywhere. There appears to me no more reason to treat the lichens as a distinct taxonomic group than to separate out the plants of the salt marsh because they are Halophytes. The Lichens represent a highly specialized ecological group, but still ecological and not morphological and by no means taxonomic. According to the biological conceptions of to-day taxonomy is the attempt to express in diagrammatic form the phylogenetic relationships of the organic world. To constitute the Lichens a distinct taxonomic group would be a violation of our present conceptions, for there is no reason to believe that the lichens as such have sprung from a common ancestral type. The taxonomy of these plants ought to be built upon the fungal rather than the algal phylogeny. For the algal portion, I believe in all cases, can and does maintain an independent existence, and as autonomous organisms have received their proper taxonomic treatment. Moreover the algal portion undergoes little morphological modification by reason of the lichen association, and hence their separate treatment in this way will not introduce confusion. The fungal portion on the other hand has in most instances undergone profound modification by reason of the association, and many of them are unable to maintain an existence separate from the alga. For this reason the fungus is always determinative of the association and the taxonomic classification must express the fungal relationship. In some instances there is undoubtedly a true lichen phylogeny, that is, forms have arisen by modification of a primitive lichen type. These would constitute genera and perhaps families all having the lichen habit, but this would not affect the general principle that ought to control the classification of these plants. I am aware that the argument offered applies in considerable degree

also to the distinction maintained between Algae and Fungi, and I do not believe that the term fungus as now used has any true taxonomic significance. The only argument I see that justifies the present retention of the Subphyllum or Series of the Fungi is that our knowledge of the phylogeny of these forms is inadequate to form a basis for a proper taxonomic classification. The Fungi Imperfecti is another case in point where the situation is more clearly perceived and is usually rightly understood. All of these cases must be regarded as temporary expedients resorted to for convenience and rendered necessary by our ignorance rather than by our knowledge. In the case of the Lichens I suppose this necessity is not now so urgent as it has been and that it is possible to approximate a correct grouping of these forms with their proper fungal relatives. If this be true, and the Lichenologist must answer that question, then we are not justified in maintaining the Lichens as a distinct class. It may be argued that the present grouping is convenient for study and should be retained. This is a return to the Linnaean system and if it were distinctly understood that such classification is only an arbitrary filing system for ready reference it might be admitted, but taxonomy stands for the representation of a deep lying biological principal and no amount of convenience justifies us in misrepresenting the truth. *Mycologist, a.*

Quotation 30

If, as I believe, it is generally agreed by taxonomists, the chief aim of taxonomy is to discover the phylogenetic relationships of plants, and group them as nearly as possible in accordance with such relationships, it is difficult to see how the lichens could be maintained as a distinct group of plants. To treat the lichens as a separate class, necessitates grouping together not only ascomycetous fungi belonging to the great groups Discomycetes and Pyrenomycetes, but also basidiomycetous fungi. Another fact furnishing the strongest evidence perhaps bearing upon the true relationship of the lichens, is the existence of genera and species having so slight an association or connection with algae as to make it difficult for lichenologists to determine whether they should be called plain pyrenomycetous or discomycetous fungi or

should be classified as lichens. Grouping and associating lichens with their nearest relatives among the fungi would also facilitate the study of their relationships and tend to bring about a better understanding of both. *Mycologist, Pathologist, a.*

Quotation 31

The fungi are fungi and the algae are algae. The present method consists simply in classifying colonies. This may be useful as an artificial method of recognizing the fungi and algae concerned, but it is scarcely a natural classification of organisms. The fungus part should be distributed among the fungi and the algae among the algae. *Morphologist, Systematist, a.*

Quotation 32

The lichens should be distributed among the fungi from the theoretical point of view. The lichens are the results of the symbiosis of algae and fungi, just comparable to that of tubercle-bacteria to the Leguminosae. The lichens cannot be considered as a distinct class, for the same reason that we cannot consider the Leguminosae with tubercles to be a distinct class from those without tubercles. *Anatomist, Physiologist, a.*

Quotation 33

I assume that classification is good only in so far as it reflects phylogeny. Since I am convinced that Verrucarias came from black fungi and Lecideas from cup fungi, for example, there is nothing left for me to do but take these out of the common group lichens, and place them as near the ancestral forms as possible. Naturally this connection is even more evident in hymeno-lichens, which make the usual grouping of lichens still more artificial. To me, the lichen presents a particular food-habit among fungi, just as fungi do among plants generally, and I would no more place so-called pyreno-, disco- and hymeno-lichens together than bacteria, molds, mushrooms, dodders, etc. *Ecologist, Mycologist, a.*

Quotation 34

Lichens should be distributed among the fungi as rapidly as their relationships are pretty clearly made out. Among my reasons for such distribution are the following: (*a*) An arrangement of plants (classification) should represent real relationship. (*b*) We now know enough regarding the affinities of the fungi concerned to enable us to treat them as parasitic fungi, and therefore to give them place among fungus genera and families. (*c*) To maintain the lichens as a separate "class" of plants is distinctly misleading to the botanical student. *Morphologist, a.*

Quotation 35

I am inclined to classify botanists into two groups so far as they hold definite opinions. One group considers classification and nomenclature generally as a means of identifying specimens or things and cares very little about the significance which the system or names may be supposed to exhibit inside the group or to outside forms. Convenience in finding or applying a name largely dominates other considerations. Such botanists are conservative; they want as little change as possible and are usually well satisfied with a crude system if it has once received the sanction of authority and become fairly well known. The second class is eager to make the classification and nomenclature fit into a general scheme of relationship which takes into consideration, not only the convenience of finding and applying names, but also the fullest indication of biological relationship and affinities between members of the group and outside forms as well. I believe such botanists, as a rule, deprecate change on account of the inconvenience which results, quite as much as do the first class, but believe that temporary inconvenience should be endured because of the greater development and clearer understanding which the new system permits. From this crude statement I think you will readily gather that I believe that distributing the lichens with the fungi better illustrates the relationship which these organisms hold to other plants than could be done by maintaining them as a distinct class. *Mycologist, Pathologist, a.*

Quotation 36

Classification should be based on homologies and evolutionary descent. I believe that the Lichens have been derived directly from Fungi. They are a polyphyletic group, hence should be classified in the various groups of fungi. The lichens may be retained as a group for convenience as we speak of fungi and algae, of parasites and saprophytes, etc. But when appearing in a general system they should be distributed among the fungi. There is no question in my mind but that the fungus and the alga parts of a lichen are distinct entities. The fungus spores do not produce algal cells nor the algal cells hyphae. The lichens show more definite relationship to certain groups of fungi than to each other. *Morphologist, a, 2–* (*1*[a]).

Quotation 37

For availability in a large library and herbarium devoted to the whole field of botany, publications on lichens and specimens of lichens are almost of necessity treated as representing a distinct group of thallophytes, because the bulk of taxonomic literature referring to them shows this line of cleavage. Nevertheless, if I were a lichen specialist, with a library and collection devoted mainly to thallophytes and largely to lichens, I should arrange both library and herbarium with reference to the proper position of the different genera in a rational classification of plants as a whole,—unless, indeed, my personal convenience in reference dictated a continuation of the old arrangement, in which case I should follow it for convenience' sake, on the same line of argument that leads one man to alphabetize the genera of a family or the species of a genus, or another man to arrange them both in phylogenetic sequence in his collection. From my limited knowledge of lichens, I should feel disposed, if entering on their study, to treat them in my publications as part of the larger group, unless I found that so made up my publications were certain to fail to find incorporation in the literature of lichens in libraries,—when I might once more bend purely theoretical considerations to those more directly practical in securing the end for which I was publishing. *Systematist, a, 1–, 12–?,* (*1*[a]?) (*1*[p]).

Quotation 38

With respect to their hyphae and their fruiting bodies, the lichens show the same development and the same structure as the ascomycetous fungi. The lichens differ from the Ascomycetes only through their living with algae. Completely similar Ascomycetes without Algae have been shown to exist, for instance, among the Patellariaceae, the Verrucariaceae, etc. Very many Ascomycetes have variously constructed stromata. The lichen-thallus appears in its diversity, corresponding to the stromata of the Ascomycetes, through the various algal colonies living and growing within it, and through the condition of living and nourishing of this stroma thereby induced. Very frequent parallelism of the Ascomycetes and lichens is proven, and a *distribution of the lichens among the Ascomycetes is possible and admissible. Mycologist, a, 1– (1ᵃ).**

Quotation 39

I do not think lichens could be maintained as a distinct class as the term class is understood in taxonomy. In a natural system of plants, I believe, they should be associated with the fungi according to structural characters. It might, however, be very convenient to treat of them separately from the fungi as lichens. Their relations with the algae with the peculiar structure they form rather make them, as a whole, of special interest apart from other groups or associations of plants. For this reason certain persons have interested themselves in the lichens just as some interest themselves in the parasitic fungi rather than the fungi as a whole. There will probably always be an interest and necessity

* Die Lichenes zeigen in Bezug auf ihre Hyphen und ihre fruchtbildenden Organe die gleiche Entwicklung und die gleiche Ausbildung mit den Ascomyceten der Fungi. Die Lichenes unterscheiden sich von den Ascomycetes nur durch ihr zusamenleben mit Algen, völlig gleiche Ascomyceten ohne Algen sind, z. B. bei den Patellariaceen, Verrucarieen, etc. erwiesen. Zahlreichste Ascomyceten haben verschieden gebildete Stromata. Der Flechten-Thallus in seiner Mannigfaltigkeit entsteht, als dem Stroma der Ascomyceten entsprechend, durch die verschiedenen in ihm lebenden und gedeihenden Algen-Colonien und die dadurch veranlasste Lebens- und Ernährungsweise dieses Stroma. Vielfachste Parallelität der Ascomyceten und Lichenen ist erwiesen, eine *Aufteilung der Lichenes unter die Ascomyceten möglich und statthaft.*

for treating the parasitic fungi separately from the other fungi. So that we have and will have, probably, courses on parasitic fungi, books on parasitic fungi and exsiccati of parasitic fungi, etc. It seems to me the treatment of the lichens in books and the study of them by those interested in them occupies very much the same relation, as a whole, as the study and treatment of the parasitic fungi. *Mycologist, Morphologist, a, 2–* (1^a).

Quotation 40

In a strictly scientific classification, the lichens must be placed under the fungi; the class lichens, as an independent group, must therefore be abandoned. However, these plants may, for the sake of practical combinations, be segregated as a separate group of fungi, as the phytopathologists do respecting the parasitic fungi, in that they consider these artificially separated from other fungi. The works of Schneider, Pierce, my own researches, . . . serve as the foundation for my opinion. It follows from all of these works, that the lichens represent fungi which live parasitically on algae. *Lichenist, a, 2–* (1^a).*

Quotation 41

It seems plain to me that the lichens must be abandoned as a special systematic class. 1. Because they represent no uniform organisms. 2. Because they are not a homogeneous group; for, as is well known, various classes of fungi on the one side and of algae on the other side may take part in their formation. Lichens are to be considered only as a biological group, somewhat as the plants with mycorrhiza or the animals with Zoochlorelae and show among themselves greater systematic differentiation than for instance the insect inhabiting plants or the epiphytes. But who

* Bei einer streng wissenschaftlichen Klassification, müssen die Flechten unter den Pilzen plaziert werden; die Klasse der Flechten, als selbständige Gruppe, muss daher kassiert werden. Jedoch können dieselben, wegen practischer Kombinationen, als eine separate Gruppe von Pilzen ausgeschieden werden, wie dies z. B. die Phytopathologen bezüglich der parasitischen Pilze tun, indem sie dieselben künstlich von den anderen Pilzen abgesondert betrachten. Als Grundlage zu dieser meiner Meinung dienen die Arbeiten Schneider's, Pierce's, meine eigene Untersuchungen. . . . Aus allen diesen Arbeiten folgt, dass die Flechten Pilze darstellen, die auf Algen parasitiren.

would think of grouping these last together with their hosts as a systematic class? In spite of this it may seem best under certain circumstances to maintain the old arrangement for floristic or ecologic purposes, but never for systematic purposes. *Physiologist, a,* 8–. (*1[a]*).*

Quotation 42

Theoretically I consider it absolutely correct to distribute the lichens among the fungi, and for the following reasons. The classification of fungi is really based in the main upon the morphological relationships of the reproductive areas and in the lichens also these relationships surely have greater importance in classification than the form-relationships of the thallus. Since the structure and development of the fruits of lichens correspond to that of the Thelephoraceae, the Pyrenomycetes, the Hysteriaceae, the Phacidiaceae, the Pezizaceae, etc., I see no reason why one should not distribute the lichens into these groups. Of course it is not impossible that there will be small groups which will be represented only by lichens, just as there will also be many groups of fungi that are represented by no lichens. So lies the matter in theory. But in practice, for instance for presentation in lectures or in text-books, it will always remain clearer, if one treats the lichens as a whole on account of their peculiar and uniform biological relationships. *Mycologist, b, 2*–. (*1[b]*).†

* Es scheint mir klar, daşs die Flechten als besondere systematische Klasse gestrichen werden müssen. 1. Weil sie keine einheitlichen Organismen darstellen. 2. Weil sie auch unter sich nicht gleichartig sind; denn bekanntlich können an ihrer Bildung verschiedene Klassen von Pilzen einerseits und von Algen anderseits teilnemen. Sie sind also nur als biologische Gruppe aufzufassen, etwa wie die Pflanzen mit Mikorrhizen oder die Tiere mit Zoochlorellen und zeigen unter sich grössere systematische Differenzen als z. B. die Insektinoren oder die Epiphyten. Wer aber würde gar daran denken, letztere mit ihren Wirten zu einer systematischen Klasse zusammenzufassen? Trotzdem kann es sich unter Umständen als zweckmässig erweisen für floristische oder okologische Zwecke, nie aber für systematische, die alte Einteilung aufrecht zu erhalten.

† Theoretisch halte ich es unbedingt für das Richtige, die Flechten unter die Pilze zu vertheilen und zwar aus folgenden Gründen. Die Klassifikation der Pilze gründet sich doch eigentlich im ersten Sinne auf die morphologischen Verhältnise der Fruchtkörper und auch bei den Flechten kommen diesen Verhältnissen sicher eine grössere Bedeutung für die Klassifikation zu, als den

Summary and Conclusions

1. About 83 per cent. or five sixths of 115 botanists believe that the lichens should be maintained as a distinct group of plants.

2. About 17 per cent. or one sixth of 115 botanists believe that lichens should be distributed among other fungi to the exclusion of the group Lichenes.

3. Of the 83 per cent. who favor maintaining the group Lichenes about 12 per cent. think that distribution is admissible.

4. So about 26 per cent. of the 115 botanists think distribution either desirable or admissible.

5. Lichenists stand almost universally for maintaining Lichenes because a natural group.

6. Yet seventeen (17) botanists other than lichenists, or about 20 per cent. of other botanists, favor distribution of lichens, while about 80 per cent. of botanists other than lichenists favor maintaining the group. So the views of lichenists have not greatly influenced the results as given in one (1) and two (2) above.

7. Europeans are more favorable to maintaining lichens as a natural group of plants than are Americans.

8. The figures in the first table show that, lichenists excepted, convenience has had greater weight than naturalness of the group in causing so large a per cent. of botanists to favor maintenance.

9. Forty (40) botanists favored maintaining Lichenes because a natural group and 22 favored distributing these plants because not a natural group. So leaving out of account every consideration except naturalness, more than half as many favor distribution as there are in favor of maintenance.

10. Leaving lichenists out of the consideration, 25 other

Formverhältnissen der Thallus. Da nun um Bau und Entwicklung der Flechtenfruchtkörper ganz demjenigen der Thelephoraceen, Pyrenomyceten, Hysteriaceen, Phacidiaceen, Pezizaceen, etc. entsprechen, so sehe ich keinen Grund ein wesshalb man die Flechten nicht auch in diese Gruppen vertheilen sollte. Dabei ist natürlich nicht ausgeschlossen, dass es dann auch kleinere Gruppen geben wird, die nur durch Flechten vertreten sein werden, ebenso wie es ja auch viele Gruppen von Pilzen gibt, die durch keine Lichenen repraesentirt sind. So liegen die Dinge in der Theorie. In Praxi aber, z. B. in der Darstellung für die Vorlesungen oder in der Lehrbüchern wird es doch immer anschaulicher bleiben, wenn man die Flechten für sich im Zusammenhange behandelt wegen ihrer eigenartigen und einheitlichen biologische Verhältnissen.

botanists favor maintaining lichens because a natural group, and 17 favor distributing lichens because not a natural group.

11. Botanists have plainly favored maintaining the group Lichenes, even as a natural group, but about as much for the sake of convenience in study.

12. There has been a considerable growth of opinion in favor of the distribution of lichens. This change of opinion has occurred since the announcement of Schwendener's views in 1868, and probably most of it very recently. Lichens have been distributed in writings by Bessey and Clements and in Nebraska and California lists of lichens, but without statement of reason for such distribution. The first careful arguments published in favor of distributing lichens appear in this paper.

The writer wishes to thank the botanists whose names appear below for replying to the circular letter.

Arthur, J. C., Mycologist, Pathologist, Indiana.
Atkinson, Geo. F., Mycologist, Morphologist, New York.
Banker, Howard J., Mycologist, Indiana.
Barnes, C. R., Physiologist, Illinois.
Baur, Erwin, Morphologist, Germany.
Bennett, A., Systematist, England.
Bessey, C. E., Morphologist, Nebraska.
Bitter, Georg. Lichenist, Germany.
Blackman, V. H., Mycologist, England.
Bower, F. O., Morphologist, Scotland.
Bresadola, G., Mycologist, Austria.
Britton, N. L., Systematist, New York.
Brooks, F. T., Mycologist, England.
Burrill, T. J., Mycologist, Pathologist, Illinois.
Burt, E. A., Mycologist, Vermont.
Calkins, W. W., Lichenist, Illinois.
Campbell, D. H., Morphologist, California.
Chamberlain, Chas. J., Morphologist, Illinois.
Cheel, Edwin, Lichenist, Australia.
Chodat, R., Miscellaneous, Switzerland.
Clements, Frederic E., Ecologist, Mycologist, Minnesota.
Clinton, G. P., Mycologist, Pathologist, Connecticut.
Conard, H. S., Morphologist, Iowa.
Coulter, John M., Morphologist, Illinois.
Coville, Frederick V., Systematist, Washington, D. C.
Curtis, C. C., Morphologist, Physiologist, New York.
Dangeard, P. A., Morphologist, France.
Darbishire, Otto V., Cryptogamist, Lichenist (?), England.
Davis, B. M., Cryptogamist, Morphologist, Massachusetts.
Durand, E. J., Mycologist, Missouri.
Earle, F. S., Mycologist, Pathologist, Cuba.
Elenkin, A., Lichenist, Russia.
Engler, A., Morphologist, Germany.
Evans, Alexander W., Bryologist, Connecticut.
Famintzyn, A. S., Physiologist, Russia.
Farlow, W. G., Mycologist, Pathologist, Massachusetts.
Farmer, J. B., Morphologist, England.
Fischer, Ed., Mycologist, Switzerland.
Freeman, E. M., Mycologist, Pathologist, Minnesota.

Fries, Th. M., Lichenist, Miscellaneous, Sweden.
Frye, T. C., Morphologist, Systematist, Washington.
Fünfstück, M., Lichenist, Germany.
Gallöe, O., Lichenist, Denmark.
Ganong, W. F., Physiologist, Massachusetts.
Goebel, K. E., Morphologist, Germany.
Hackel, E., Agrostologist, Austria.
Harper, R. A., Morphologist, Mycologist, Wisconsin.
Harshberger, John W., Ecologist, Mycologist, Pennsylvania.
Hasse, H. E., Lichenist, California.
Hedlund, T., Lichenist, Sweden.
Herre, A. C., Lichenist, California.
Hitchcock, A. S., Agrostologist, Washington, D. C.
Howe, R. Heber, Jr., Lichenist, Massachusetts.
Hue, A. M., Lichenist, France.
Ikeno, S., Anatomist, Physiologist, Japan.
Johnson, D. S., Morphologist, Maryland.
Jones, L. R., Mycologist, Pathologist, Wisconsin.
Jost, L., Miscellaneous, Germany.
Klebahn, H., Mycologist, Germany.
Kny, L., Anatomist, Physiologist, Germany.
Lindau, G., Mycologist, Lichenist, Germany.
Lloyd, Francis E., Morphologist, Physiologist, Alabama.
Lotsy, J. P., Morphologist, Holland.
Macbride, Thos. H., Mycologist, Iowa.
MacDougal, D. T., Physiologist, Arizona.
Macoun, John, Cryptogamist, Canada.
Magnus, Paul, Mycologist, Physiologist, Germany.
Maiden, J. H., Systematist, Australia.
Massalongo, C., Miscellaneous, Italy.
Mattirolo, O., Anatomist, Mycologist, Italy.
Merrill, G. K., Lichenist, Maine.
Miller, Mary F., Lichenist, Washington, D. C.
Möller, A., Mycologist, Physiologist, Germany.
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Mottier, D. M., Morphologist, Indiana.
Murrill, W. A., Mycologist, New York.
Nölle, E., Systematist, Germany.
Olive, E. W., Morphologist, South Dakota.
Pammel, L. H., Morphologist, Mycologist, Iowa.
Patouillard, N., Mycologist, France.
Peck, Chas. H., Mycologist, New York.
Peirce, George J., Physiologist, California.
Penhallow, D. P., Morphologist, Canada.
Penzig, O., Systematist, Italy.
Prain, D., Systematist, Phytogeographer, England.
Pringsheim, Ernst G., Physiologist, Germany.
Rehm, H., Mycologist, Germany.
Reinke, J., Physiologist, Lichenist (?), Germany.
Ricker, P. L., Mycologist, Washington, D. C.
Riddle, Lincoln W., Lichenist, Massachusetts.
Romell, L., Mycologist, Sweden.
Rose, J. N., Systematist, Washington, D. C.
Rostrup, Ove, Mycologist, Denmark.
Saccardo, P. A., Mycologist, Italy.
Schaffner, John H., Morphologist, Ohio.
Schneider, Albert, Lichenist, Medical Botany, California.
Schröter, C., Systematist, Switzerland.
Schwendener, S., Anatomist, Physiologist, Germany.
Scriba, L., Lichenist, Germany.
Selby, A. D., Mycologist, Pathologist, Ohio.
Shear, C. L., Mycologist, Pathologist, Washington, D. C.

Sheldon, John C., Cryptogamist, Pathologist, West Virginia.
Smith, Annie Lorain, Lichenist, England.
Smith, Erwin F., Mycologist, Pathologist, Washington, D. C.
Spalding, V. M., Morphologist, California.
Stahl, E., Biologist, Germany.
Strasburger, E., Anatomist, Germany.
Sweetser, A. R., Lichenist, Oregon.
Tansley, A. G., Anatomist, Physiologist, England.
Thaxter, Roland, Mycologist, Massachusetts.
Thomas, M. B., Morphologist, Pathologist, Indiana.
Trelease, William, Systematist, Missouri.
Vines, Sidney H., Morphologist. England.
Wiegand, Karl M., Mycologist, Pathologist, New York.
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THE AGARICACEAE OF TROPICAL NORTH AMERICA—IV

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All of the tropical genera with rose-colored spores are treated in this article. Those growing mostly on dead wood, like *Pluteus,* are well represented; while those growing normally in the soil, like *Entoloma,* have few tropical species. The probable reason for this has been discussed in a previous article. As may be seen from the following key, only one of the genera is provided with a volva, and this contains few species. None of the species possesses an annulus. The principal characters used in distinguishing genera are the attachment of the gills and the consistency of the stipe, which may at times leave the position of a species rather in doubt.

Volva and annulus wanting.	
Stipe slender, cartilaginous.	
Margin of pileus incurved when young.	
Lamellae adnate or adnexed.	1. LEPTONIELLA.
Lamellae decurrent.	2. ECCILIA.
Margin of pileus straight and appressed when young; lamellae free or adnexed.	3. NOLANEA.
Stipe fleshy, usually stout.	
Lamellae free.	4. PLUTEUS.
Lamellae sinuate or adnexed.	5. ENTOLOMA.
Lamellae decurrent.	6. PLEUROPUS.
Volva present, annulus wanting.	7. VOLVARIOPSIS.

1. LEPTONIELLA Earle, Bull. N. Y. Bot. Gard. 5: 424. 1909

Leptonia (Fries) Quél. Champ. Jura Vosg. 88. 1872. Not *Leptonium* Griff. 1843.

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This genus includes species with adnate or adnexed lamellae and cartilaginous stipe, the margin of the pileus being incurved when young instead of straight as in *Nolanea*. The plants are usually small, with attractive blue, gray, or purple coloring. Only two species have been previously described from our tropics.

1. **Leptoniella hypoporphyra** (Berk. & Curt.)

Agaricus (Leptonia) hypoporphyrus Berk. & Curt. Jour. Linn. Soc. **10**: 289. 1868.

Described from Wright's Cuban collections and found later in Guadeloupe by Duss. The spores are angular, 7–9 μ. The types at Kew are in poor condition.

2. **Leptoniella miniata** (Pat.)

Leptonia miniata Pat. Bull. Soc. Myc. Fr. **16**: 176. 1900.

Collected on dead trunks of various trees in Guadeloupe by Duss. Pileus red, striate; spores angular, 10–13 μ. Abundantly represented in Dr. Patouillard's herbarium.

3. **Leptoniella atrosquamosa** sp. nov.

Pileus broadly convex, slightly depressed, regular, solitary, 2 cm. broad; surface avellaneous, striate, clothed with innate, imbricate, fuliginous scales which are upturned at the end, the depressed umbo being decorated with black tufted scales; lamellae adnate, narrow, distant, about three times inserted, edges entire, concolorous; spores angular, 8–10 μ; stipe cylindric, equal, murinous, 3.5 cm. long, 2–3 mm. thick.

Type collected on dead wood at Morce's Gap, Jamaica, 5000 ft. elevation, December 30, 1908, *W. A. & Edna L. Murrill 708.* Resembling *L. serrulata* in general appearance.

4. **Leptoniella Earlei** sp. nov.

Pileus convex, umbilicate, thin, solitary, 2 cm. broad; surface pale-tan, subfurfuraceous, the disk scaly, margin thin, not striate; lamellae adnexed, distant, broad, dirty-pink, heterophyllous; spores angular, irregular, 10–13 $\times$ 7–8 μ; stipe cylindric, glabrous, subpruinose above, slightly paler than the pileus, hollow, 4 cm. long, 2 mm. thick.

Type collected on the ground in woods on El Yunque, Cuba, 1800 ft., March, 1903, *Underwood & Earle 427.*

5. **Leptoniella cinchonensis** sp. nov.

Pileus thin, irregular, convex, umbilicate, gregarious, 2–2.5 cm. broad, less than 1 cm. high; surface dry, striate, avellaneous, fuliginous at the center, margin lobed; lamellae adnate, rather broad and distant, pale-russet; spores angular, uninucleate, 10–12 $\times$ 7–9 μ; stipe cylindric, smooth, fumosous, slightly tapering upward, 3 cm. long, 2.2 mm. thick.

Type collected on the ground on a shaded bank at Cinchona, Jamaica, 5000 ft. elevation, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 562.*

6. **Leptoniella mexicana** sp. nov.

Pileus convex to expanded, umbilicate, gregarious, 1.5 cm. broad; surface smooth, silky-fibrillose, pale-avellaneous, margin thin, fragile; lamellae adnate, broad, distant, heterophyllous, pale ashy-gray with a slight rosy tint; spores polygonal, uninucleate, 7 $\times$ 4.5–5 μ; stipe slightly larger below, concolorous, glabrous, cartilaginous, 2.5 cm. long, 1.5 mm. thick.

Type collected on the ground in humus in a coffee plantation near Orizaba, Mexico, January 10–14, 1910, *W. A. & Edna L. Murrill 837.*

2. ECCILIA (Fries) Quél. Champ. Jura Vosg. 90. 1872

Hyporhodius Schröt. Krypt. Fl. Schles. 3^1: 613. 1889.

A small genus readily distinguished by its cartilaginous stipe and decurrent gills. One species, *E. rhodocylix,* has been reported from Cuba and Bermuda, but such tropical material as I have seen so determined does not agree with the European plant.

1. ECCILIA ATRIDES (Lasch) Quél. Champ. Jura Vosg. 90. 1872

A well-known European and temperate North American species reported as far south as North Carolina. The edges of the gills are black and denticulate; spores angular, 7–9 μ.

Troy and Tyre, Jamaica, *W. A. Murrill & W. Harris 1069;* Jalapa, Mexico, *W. A. & Edna L. Murrill 77.*

2. **Eccilia cubensis** sp. nov.

Pileus convex, 1 cm. broad; surface dark-tan, darker at the disk, innate-scaly, not striate; lamellae decurrent, rather distant,

broad, dirty-white to slightly pinkish; spores octahedral, irregular, 7–9 μ; stipe cylindric, paler than the pileus, slightly granular-floccose, 2 cm. long, 1 mm. thick.

Type collected in a thicket on the bank of a stream near Herradura, Cuba, October 14, 1906, *F. S. Earle 554*.

3. **Eccilia Earlei** sp. nov.

Pileus thin, convex-umbilicate, 2 cm. broad; surface pale-tan, fibrillose-scaly, margin thin, substriate; lamellae decurrent, distant, broad, subarcuate, yellow to pinkish; spores irregularly angled, 7–9 μ; stipe cylindric, hollow, glabrous, dull-yellow, 4 cm. long, 2 mm. thick.

Type collected on a dead stick on El Yunque, Cuba, 1800 ft., March, 1903, *Underwood & Earle 428*.

4. **Eccilia jamaicensis** sp. nov.

Pileus thin, convex, umbilicate, solitary, nearly 2 cm. broad; surface smooth, glabrous, blackish, margin entire, concolorous; lamellae broad, distant, decurrent, straw-yellow; spores angular, pinkish, 8–10 $\times$ 7 μ; cystidia none; stipe equal, hollow, flattened on drying, cartilaginous, glabrous, ardesiacous, 2 cm. long, 2 mm. thick.

Type collected on decayed wood at Chester Vale, Jamaica, 3000 ft., December 21–24, 1908, *W. A. & Edna L. Murrill 367*.

3. NOLANEA (Fries) Quél. Champ. Jura Vosg. 89. 1872

This genus has a cartilaginous stipe, free or adnexed gills, and a campanulate cap with straight margin. Berkeley described one species from Bermuda, and reported one of our northern species, *N. Babingtonii*, from Cuba. Several species appear to occur in South America.

1. NOLANEA HELICTA (Berk.) Sacc. Syll. Fung. **5**: 729. 1887

Agaricus (*Nolanea*) ***helictus*** Berk. Jour. Linn. Soc. **15**: 48. 1877.

Collected by the Challenger Expedition on rotten leaf-mould in Bermuda. Several type specimens are at Kew. The name refers to the twisted stipe.

2. **Nolanea cubensis** sp. nov.

Pileus thin, convex to subexpanded, subumbonate, 2–3 cm. broad; surface pale-fuscous, minutely silky-fibrillose, at length rimose, striate to the umbo; lamellae free, crowded, rather broad, ventricose, white to pale-roseous; spores subglobose, smooth, 6 μ; cystidia none; stipe cylindric, solid, white, glabrous above, brownish-flocculose at the base, 3 cm. long, 2 mm. thick.

Type collected on a piece of board on the ground in a coffee grove at Santiago de las Vegas, Cuba, August 29, 1904, *F. S. Earle 155*.

3. **Nolanea jamaicensis** sp. nov.

Pileus campanulate with conic umbo, about 4 cm. broad; surface striate, glabrous, avellaneous, umbrinous to fuliginous at the umbo, margin entire, concolorous; lamellae rather broad, close, adnexed, salmon-colored from the copious spores, which are angular, somewhat longer than broad, 9–11 $\times$ 7–9 μ; stipe cylindric, equal, smooth, glabrous, pale-avellaneous, 6 cm. long, 3 mm. thick.

Type collected at Cinchona, Jamaica, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 566*.

4. PLUTEUS Fries, Gen. Hymen. 6. 1836

This genus is best known through its large and common representative, *P. cervinus*. The lamellae are free, the stipe fleshy or fibrous, and most of the species are found on decayed wood. The spore characters are similar throughout the genus. Cystidia occur rarely, and in one species they are peculiar in having the apex divided into two or more points.

1. PLUTEUS CERVINUS (Schaeff.) Quél. Champ. Jura Vosg. 81. 1872

Abundant in various forms throughout the United States and Europe on decayed wood and sawdust piles. Spores ellipsoid, smooth, 7–8 $\times$ 5–6 μ; cystidia bottle-shaped, large and conspicuous, divided at the apex into two, three, or more points. The tropical stations given below are all at 5000 ft. elevation.

Cinchona, Jamaica, *W. A. & Edna L. Murrill 452, 602;* Jalapa, Mexico, *W. A. & Edna L. Murrill 164;* Cuernavaca, Mexico, *W. A. & Edna L. Murrill 380.*

2. **Pluteus reticulatus** sp. nov.

Pileus plane to depressed, umbonate, solitary, 5 cm. broad, about 1 cm. thick; surface velvety, dark-isabelline with pale-fuliginous reticulations, which are more pronounced on the umbrinous umbo; lamellae free, ventricose, salmon-colored; spores subglobose, smooth, uninucleate. $4–5 \times 3.5–4\,\mu$; cystidia fusiform, pointed, not divided at the apex, rather abundant, about $60 \times 17\,\mu$; stipe cylindric, subequal, glabrous, stramineous with a pale-melleous tint, 4 cm. long, 5 mm. thick.

Type collected on dead wood near Moneague, Jamaica, about 2000 ft., January 17–18, 1909, *W. A. Murrill 1159*.

3. PLUTEUS NITENS Pat. Bull. Soc. Myc. Fr. **14**: 53. 1898

Type collected by Paul Maury on dead wood at Motzorongo, Mexico, February 12–25, 1891. The original specimens, accompanied by a drawing, are in the herbarium of Dr. N. Patouillard, in Paris.

Motzorongo, Mexico, *Maury, W. A. & Edna L. Murrill 1028, 1055;* Santiago de las Vegas, Cuba, *Earle 260, 501.*

4. **Pluteus Earlei** sp. nov.

Pileus rather thick, expanded, somewhat gibbous, 10 cm. broad; surface dry, densely floccose, uniformly pale-yellow, margin even, not striate; lamellae free, crowded, broad, becoming dull-pinkish; spores regular, ovoid, smooth, uninucleate, dark-pink when fresh, $7–8 \times 6\,\mu$; cystidia none; stipe slightly tapering upward, solid, white, glabrous, 8 cm. long, 1 cm. thick.

Type collected on a dead log near Guanajay, Cuba, September 14, 1904, *F. S. Earle & P. Wilson 1525*. Similar to *Pluteus cervinus* in size and shape, but differing in several important characters.

5. **Pluteus rimosus** sp. nov.

Pileus conic to convex, 4–5 cm. broad, 2–3 cm. high, gregarious; surface fuliginous when young, becoming umbrinous, smooth, glabrous, at length radiate-rimose and showing white in the cracks; lamellae free, close, rather narrow, white, becoming roseous from the spores; spores regular, globose, smooth, uninucleate, $4\,\mu$; cystidia none; stipe white, glabrous, much enlarged below, crooked, 4.5 cm. long, scarcely 1 cm. thick above, 2 cm. thick at the base.

Type collected in a field near the shore east of Port Antonio, Jamaica, on soil mixed with decayed wood, December 17, 1908, *W. A. Murrill 214*.

6. **Pluteus multistriatus** sp. nov.

Pileus convex, depressed about the umbo, somewhat clustered, 3 cm. broad; surface fuliginous, subglabrous, with numerous shallow furrows, or striations, extending from the umbo to the margin; lamellae free, close, broad, pallid; spores globose or subglobose, smooth, uninuculeate, 5–7 μ; cystidia none; stipe slender, equal, glabrous, white, 4 cm. long, 2–3 mm. thick.

Type collected on a decayed railway tie at Jalapa, Mexico, 5000 ft., December 12–20, 1909, *W. A. & Edna L. Murrill 111*. No. 112 of the same collection represents depauperate forms of this species.

7. **Pluteus Harrisii** sp. nov.

Pileus convex to depressed, obtuse, 2–3 cm. broad; surface avellaneous-fuliginous to dark-chestnut, glabrous, subrugose, finely asperate and striate; lamellae free, subcrowded, slightly ventricose, white to salmon; spores broadly ellipsoid to subglobose, regular, smooth, uninucleate, about 7 μ long, rarely 9 μ, and 5–6 μ broad; cystidia none; stipe cylindric, solid, white, glabrous, shining, 3–4 cm. long, 2–3 mm. thick.

Type collected on dead wood in Troy and Tyre, Jamaica, 2000 ft., January 12–14, 1909, *W. A. Murrill & W. Harris 956*. Also collected on El Yunque, Cuba, 1800 ft., March, 1903, *Underwood & Earle 425*.

8. PLUTEUS ALBORUBELLUS (Mont.) Pat. Bull. Soc. Myc. Fr. **15**: 196. 1899

Agaricus (*Mycena*) *alborubellus* Mont. Ann. Sci. Nat. IV. **1**: 96. 1854.

Originally described from French Guiana, and later collected in Guadeloupe by Duss, on dead branches of *Bignonia*.

9. PLUTEUS LAETIFRONS (Berk. & Curt.) Sacc. Syll. Fung. **5**: 677. 1887

Agaricus (*Pluteus*) *laetifrons* Berk. & Curt. Jour. Linn. Soc. **10**: 289. 1868.

Collected by Wright on rotten wood in Cuba. Pileus about

5–10 mm. broad, glabrous, radiate-striate, orange-red; lamellae yellow; stipe slender, glabrous, red.

10. **Pluteus jamaicensis** sp. nov.

Pileus thin, expanded, obtuse, subcespitose, 1–3 cm. broad; surface dark-brown, paler with age, rugose, crustose-areolate, not striate; lamellae free, subcrowded, broad, ventricose, white to pink; spores globose, smooth, 4 μ; cystidia none; stipe enlarged above and below, solid, glabrous expect at the base, which is conspicuously whitish-tomentose, 2 cm. long, 2 mm. thick.

Type collected on rotten wood at Castleton Gardens, Jamaica, October 28, 1902, *F. S. Earle 220*. The dried plants resemble closely the faded type specimens of *P. laetifrons* at Kew, but the two species are very dissimilar in a fresh condition.

11. PLUTEUS TEPHROSTICTUS (Berk. & Curt.) Sacc. Syll. Fung. **5**: 669. 1887

Agaricus (*Pluteus*) *tephrostictus* Berk. & Curt. Jour. Linn. Soc. **10**: 289. 1868.

Collected by Wright on the under side of old logs in Cuba. The types at Kew are in poor condition. Pileus 1.2 cm. broad, umbonate, white, covered with a black, glandular pubescence.

12. PLUTEUS AETHALUS (Berk. & Curt.) Sacc. Syll. Fung. **5**: 674. 1887

Agaricus (*Pluteus*) *aethalus* Berk. & Curt. Jour. Linn. Soc. **10**: 289. 1868.

Described from plants collected by Wright on rotten wood in Cuba. Pileus date-brown, less than 1 cm. broad; spores globose, 5 μ. Two small type specimens are preserved at Kew.

Cuba, *Wright 50;* Tepeite Valley, Mexico, *W. A. & Edna L. Murrill 471.*

DOUBTFUL SPECIES

Pluteus leoninus (Schaeff.) Quél. Champ. Jura Vosg. 82. 1872. A temperate species reported from Guadeloupe by Duss, but specimens not examined.

5. ENTOLOMA (Fries) Quél. Champ. Jura Vosg. 83. 1872
Rhodophyllus Quél. Ench. Fung. 57. 1886.

This genus differs from *Pluteus* in having sinuate or adnexed lamellae, corresponding to *Tricholoma* in the white-spored series. The species are abundant in temperate regions, but none have heretofore been reported from tropical America.

1. ENTOLOMA MURRAII (Berk. & Curt.) Sacc. Syll. Fung. 14: 127. 1899

Agaricus (*Entoloma*) *Murraii* Berk. & Curt. Ann. Mag. Nat. Hist. III. 4: 289. 1859.

First collected in New England by Murray, and later found as far north as Maine and as far south as Alabama. With the habit and brilliant coloring of *Hydrocybe,* it unites a peculiar shape and remarkable many-angled or irregularly stellate spores. The coloring and striation of the cap varies with age, climate, etc.

Morce's Gap, Jamaica, *W. A. & Edna L. Murrill 676;* Sir John Peak, Jamaica, *W. A. Murrill 794;* Troy and Tyre, Jamaica, *W. A. Murrill & W. Harris 881;* Rose Hill, Jamaica, *F. S. Earle 289;* British Honduras, *Morton E. Peck.*

2. **Entoloma cinchonensis** sp. nov.

Pileus hemispheric, slightly depressed at the center, solitary, 1–1.5 cm. broad; surface smooth, dry, subglabrous, ochroleucous; margin very thin, sometimes eroded; lamellae sinuate, broad, rather close, heterophyllous, pale-citrinous to salmon-colored, edges notched or irregular; spores subglobose to ovoid, smooth, $4–5 \times 3–3.5\,\mu$; stipe slightly tapering upward, smooth, glabrous, cremeous above, ochraceous below, 1.5 cm. long, 1.5 mm. thick.

Type collected on much decayed wood at Cinchona, Jamaica, 5000 ft. elevation, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 661.* Also collected on dead wood at Morce's Gap, Jamaica, 5000 ft. elevation, near Cinchona, December 29–January 2, 1908–9, *W. A. & Edna L. Murrill 687.*

6. PLEUROPUS Roussel, Fl. Calvados ed. 2. 67. 1806

Clitopilus (Fries) Quél. Champ. Jura Vosg. 87. 1872.
Rhodosporus Schröt. Krypt. Fl. Schles. 3^1: 617. 1889.

This genus has a fleshy or fibrous stem and decurrent gills. It is represented by a number of temperate species, but has heretofore been unknown in tropical America.

1. **Pleuropus abortivus** (Berk. & Curt.)

Agaricus (*Clitopilus*) *abortivus* Berk. & Curt. Ann. Mag. Nat. Hist. III. **4**: 289. 1859.

Clitopilus abortivus (Berk. & Curt.) Sacc. Syll. Fung. **5**: 701. 1887.

This species, originally described from Sprague's collections in New England and known to occur from Canada to Alabama and west to Wisconsin, is peculiar in having aborted sporophores more frequently than normally developed ones. These irregularly globose abortions, distantly resembling puff-balls, were found in the market at Jalapa, having been collected in the surrounding forests by the Indians for food.

Jalapa, Mexico, *W. A. & Edna L. Murrill 194;* Tepeite Valley, Mexico, *W. A. & Edna L. Murrill 476.*

2. **Pleuropus Earlei** sp. nov.

Pileus thin, firm, convex to subexpanded, umbilicate, gregarious, 1–2 cm. broad; surface pure-white, glabrous, margin entire, inrolled when young; lamellae short-decurrent, subcrowded, narrow, irregular, pure-white to pink; spores angular, 7×5–$6\,\mu$; stipe short, subequal, often flattened, pure-white, fistulose, minutely pruinose to glabrous, surrounded at the base with whitish mycelium, 2–3 cm. long, 2–3 mm. thick.

Collected on the ground in a banana field at Santiago de las Vegas, Cuba, from May to September, 1904, *F. S. Earle 31* (*type*), *70, 179.* The fresh specimens have a strong odor of wild onions.

7. **Volvariopsis** nom. nov.

Volvarius Roussel, Fl. Calvados ed. 2. 59. 1806. *Volvaria* (Fries) Gillet, Champ. Fr. **1**: 385. 1878. Not *Volvaria* DC. 1805.

The type of this genus is *Volvaria volvacea* (Bull.) Quél. The species are largely temperate, and form a natural group with distinctive characters, corresponding to *Amanitopsis* in the white-spored series. Only one species, *V. bombycina,* has heretofore been reported from tropical America. *Locellina hiatuloides* Pat., described from Guadeloupe, has the form and appearance of a species of this genus, but the spores are ochraceous. It is just possible that their color has become changed in drying.

1. **Volvariopsis bombycina** (Schaeff.)

Volvaria bombycina (Schaeff.) Quél. Champ. Jura Vosg. 80. 1872.

This very handsome species occurs on decayed trunks of hardwood trees from New England to Florida and west to California in the United States. It is also well-known in Europe and was collected by Wright in Cuba. The surface of the pileus is white and silky-fibrillose; the spores are broadly ellipsoid, 6–8 × 5–6 μ.

Valparaiso, Cuba, *Wright 63;* Herradura, Cuba, *F. S. Earle 564;* Guane, Pinar del Rio, Cuba, *N. L. Britton, E. G. Britton & J. F. Cowell 980.*

2. **Volvariopsis Bakeri** sp. nov.

Pileus fleshy, ovoid to convex, densely gregarious, reaching a breadth of 10 cm.; surface dark-fuliginous, becoming much lighter with age, appressed-fibrillose from the cracking of the cuticle, not striate; context white, with mild taste and no appreciable odor; lamellae free, crowded, not very broad, white, becoming pink; spores broadly ellipsoid, rarely ovoid, smooth, roseous, 6–8 × 4–5 μ; stipe tapering upward, white, glabrous, solid, 8–9 cm. long, 1–1.5 cm. thick; volva free, open, dark-fuliginous, 3–4 cm. long, 2–3 cm. broad.

Type collected on a dead banana stump at Santiago de las Vegas, Cuba, May 19, 1906, *C. F. Baker (F. S. Earle 521).*

3. **Volvariopsis jamaicensis** sp. nov.

Pileus thin, convex to nearly plane, gregarious, 5 cm. broad; surface ashy-white, avellaneous at the center, radiate-striate, slightly granular, margin thin, entire; lamellae free, close, narrow, white to salmon-colored; spores narrowly ellipsoid, smooth, uninucleate, about 5 × 3 μ; stipe curved, slightly tapering upward, glabrous, whitish, hollow, with a tough rind, 5 cm. long, 3–5 mm. thick; volva rather delicate, narrow, avellaneous, 1–2 cm. long.

Type collected on the decaying roots of an upturned tree in a virgin forest near Moore Town, Jamaica, 800 ft. elevation, December 16, 1908, *W. A. & Edna L. Murrill 150.*

4. **Volvariopsis cubensis** sp. nov.

Pileus firm, fleshy, rather tough, irregularly expanded, obtuse, solitary, 7 cm. broad, with strong, unpleasant odor; surface dark

smoky-brown, minutely fibrillose, not striate, the disk seal-brown and glabrous; lamellae free, distant, subcrowded, rather broad, subventricose, heterophyllous; spores ellipsoid, smooth, uninucleate, about $5.5 \times 3.5\,\mu$; stipe subcylindric, slightly enlarged above and below, concolorous but paler, glabrous, solid, tough, apex pallid, 6–7 cm. long, 7 mm. thick; volva thick and fleshy, cup-shaped, distant, bifid, concolorous.

Collected on the ground in a banana field at Santiago de las Vegas, Cuba, May, September, and October, 1904, *F. S. Earle 17* (*type*), *180*.

5. **Volvariopsis Earlei** sp. nov.

Pileus fleshy, rather thin, becoming expanded, solitary or gregarious, 4–5 cm. broad; surface glabrous, rarely with thin volval patches, white, discolored with age, margin even or slightly striate; lamellae free, subcrowded, of medium breadth, ventricose, white to pink; spores ellipsoid, smooth, both nucleate and granular, about $11 \times 7\,\mu$; stipe subcylindric, slightly tapering upward, glabrous, pure-white, solid, 5–10 cm. long, 5–8 mm. thick; volva delicate, sheathing, very short, 5–8 mm. in length.

Collected on the ground in a banana field at Santiago de las Vegas, Cuba, June and September, 1904, *F. S. Earle 45* (*type*), *103*, *168*. No. 103 represents a shorter and heavier form with a more strongly developed volva; the pileus is also pale-grayish instead of pure-white, but microscopic and other characters agree closely.

NEW YORK BOTANICAL GARDEN.

SCHIZOSACCHAROMYCES OCTOSPORUS

W. C. Coker and Louise Wilson

(With Plate 55, Containing 25 Figures)

In the course of some special work on wild and domestic yeasts during the fall of last year (1910) we were surprised to discover in Chapel Hill a member of the rare genus *Schizosaccharomyces* Lindner. The species appeared in the following manner: Unbroken Delaware grapes bought in the Chapel Hill market were put in a test tube, covered with distilled water, and set aside. Slow fermentation started up and a precipitate began to appear. After three weeks, an examination of the precipitate showed all stages of development, both vegetative and reproductive. A close examination showed the species to be *Schizosaccharomyces octosporus* Beyerinck. Cultures were made from this in various solutions and in most cases spore formation was secured. Fresh cultures of this yeast were also obtained later from California Tokay grapes, using the same method as with the Delaware grapes.

The genus *Schizosaccharomyces* is a small one proposed by Lindner* in 1893 to include those forms of conjugating yeast-like fungi which multiply vegetatively not by budding, as in other yeasts, but by fission, as in most cell division. The species *S. Pombe* was the first to be discovered and is the one on which the genus was founded. Since that time three other species of the genus have been described: *S. octosporus* Beyerinck,† *S. mellacei* (Jörg.) Lindner,‡ and *S. asporus* Eyckmann. Of these, *S. Pombe* and *S. mellacei* produce only four spores in conjugation, while in *S. asporus,* as the name implies, spore formation seems to be suppressed.

The members of this genus form a peculiar group of yeasts hitherto found only in hot countries, and so far little known. *S. mellacei* was found in Jamaica, *S. Pombe* in tropical Africa,

* Wochenschr. f. Braueri 10: 1298. 1893.

† Centralblatt f. Bacteriol. 16: 49.

‡ Mikr. Betriebs-kontr. Berl. 404. 1901.

and *S. octosporus* on old currants presumably from Greece. The appearance of the last at Chapel Hill is the first reported occurrence, so far as we know, of any of the genus on the American continent. Schiönning* was the first to publish observations on the conjugation of *S. octosporus*. He found that the cells destined to form the ascus divide into daughter cells which do not separate completely, but remain attached at a certain point. After some time the partition at the point of attachment is absorbed and the two sister cells fuse to form an ascus with eight spores.

Guilliermond† in 1903 confirmed these observations in large part but thought that while the fusion may take place simply by the solution of the partition wall it is generally brought about by the formation of two short projections just above the point of contact, which meet at their tips and fuse.‡

Guilliermond also studied the nuclear behavior and found that the two nuclei fuse in conjugation and then divide into eight daughter nuclei around which the eight spores are formed. This, then, is to all appearances a true case of isogamous sexual reproduction. In a later paper§ Guilliermond reports further observations on this yeast and thinks he has exaggerated a little in saying that it is always sister cells that fuse. From certain appearances, which he figures, he thinks that the fusing cells may occasionally be separated from each other by several cell divisions.

In our study of the development of *Schizosaccharomyces octosporus*, extending over several months, we largely confirmed the observations of the authors above mentioned. However, we saw no indication whatever of fusion between any but sister cells, nor any sign of conjugation through projecting tubes or processes. In plate LV, we give a series of drawings showing conjugation (figs. 14 to 25). The condition shown in figs. 17, 18 and 25 is not due in our opinion to the fusion of elongated processes, but to the drawing out of the cells after fusion. The typical series is perhaps best represented by figures 14, 15, 16, 20 and 21. Where

* Compt. Rend. des Brau. Lab. Carlsberg. 4: 1895. We have not been able to see this paper.

† Rev. Gen. de Bot. 15: 1903.

‡ This method reminds us of the conjugation in certain species of *Spirogyra* where neighboring cells may fuse by such a projection.

§ Rev. Gen. de Bot. 17: 337. 1905.

the cells divide in vegetative reproduction they do not break away all along the line, but bend back and remain attached by one corner. After a time they break away entirely and repeat the process. Figs. 1 to 10 show a reproductive series of forms and stages in ordinary growth and multiplication.

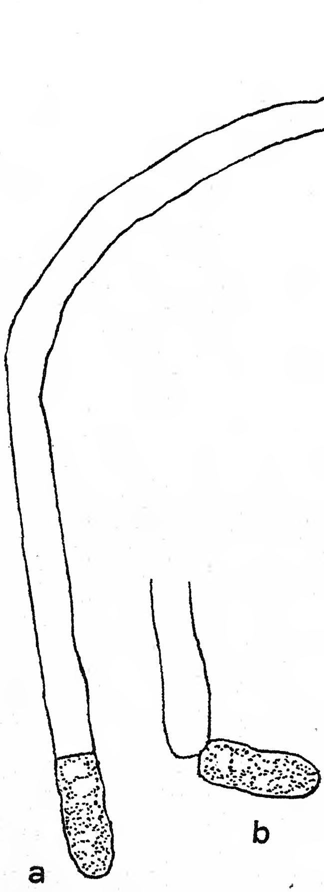


FIG. 1. An elongated hypha of *S. octosporus* cutting off a normal cell at its tip. × 670.

Even in normal vegetative growth the size of the cell varies considerably, and when food begins to fail many of the cells extend their growth into elongated hyphae which formed a conspicuous part of the mass. In fig. 13 is shown the beginning of such a hypha. As the hypha elongates the protoplasm is usually

confined to one end, where growth alone proceeds. After a time this protoplasm collects more closely into the tip and is cut off by a cross wall. This tip cell then bends around just as in ordinary division, and remains for a time attached by a point. Later it drops away and becomes a vegetative cell of normal size. In text fig. 1a, such a hypha is shown with its protoplasm cut off at one end. While this figure was being drawn the end cell was seen to bend back as shown in text fig. 1 b. Occasionally there may be seen long rows of cells as shown in text fig. 2 recalling certain figures of Lindner's for *S. Pombe*. These finally break up into separate cells.

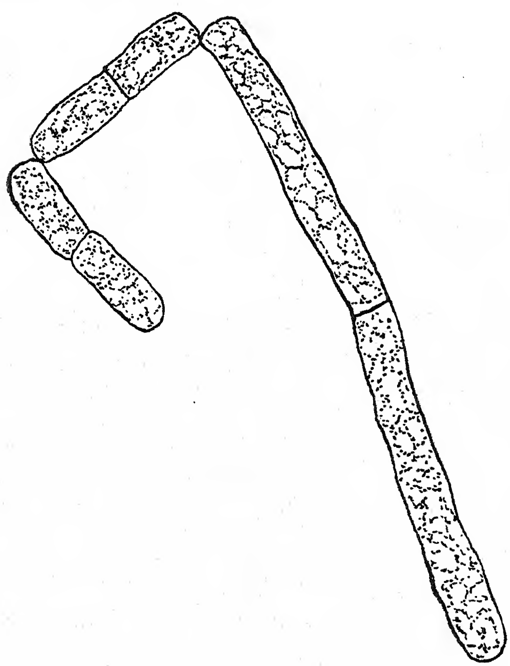
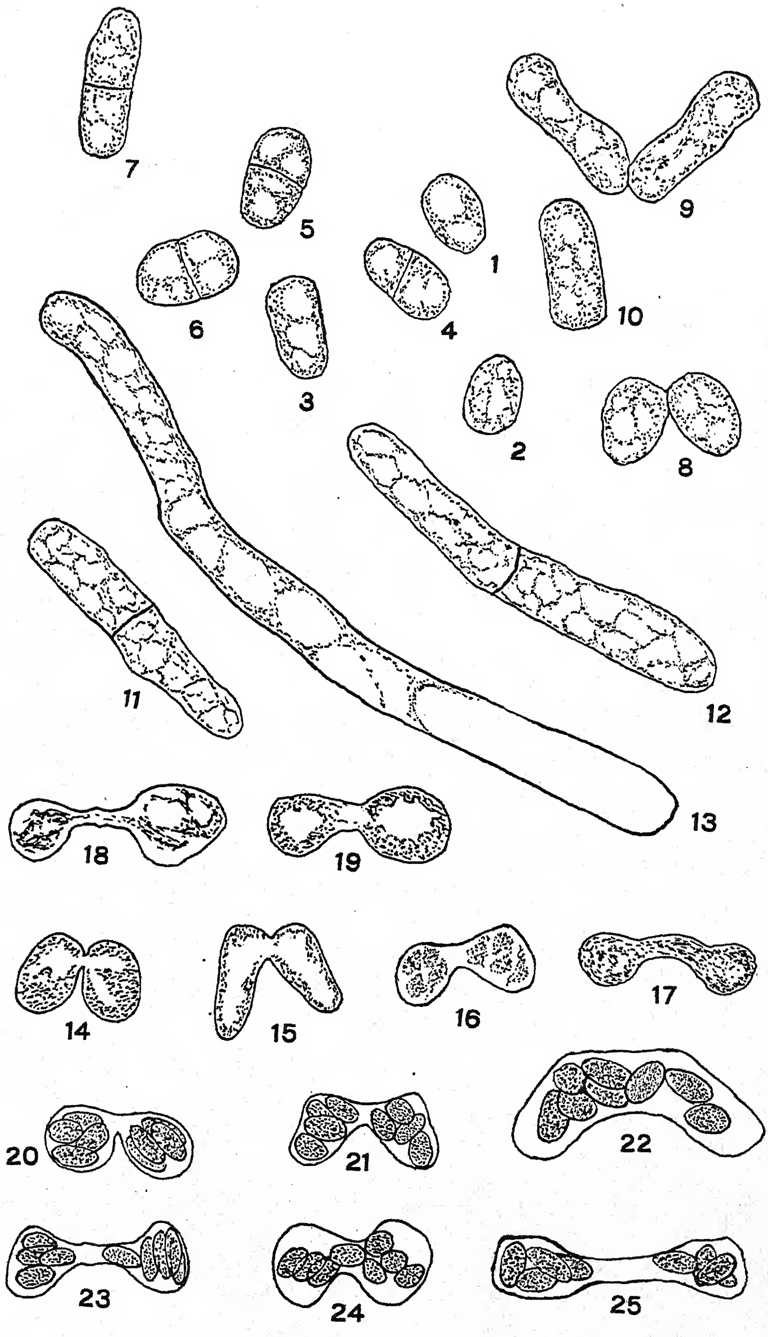


FIG. 2. Elongated cells of *S. octosporus* in rows beginning to separate. × 1080.

When fusion is to take place the procedure is exactly the same as in vegetation cell division, up to the point of the bending back of the cells. Then, instead of separating, the partition becomes absorbed and the contents of the two cells fuse. Usually, the original position of the cell is retained and the result is the formation of a double sac that resembles a pair of saddle bags (figs.



SCHIZOSACCHAROMYCES OCTOSPORUS

20, 21). This shape may be variously modified as shown in the figures. A dumbbell form is frequently seen.

In a recent paper* Guilliermond gives a good review of our present knowledge of spore formation, in the yeasts. Among them sexuality is known to appear in two ways. In *Schizosaccharomyces, Zygosaccharomyces,* and *Debaryomyces,* there is a fusion of cells before spore formation. In *Saccharomyces Ludwigii, Willia Saturnus,* and *yeast of Johannisberg II,* there is no fusion preceding the formation of spores, but the spores fuse during the act of sprouting. In a number of other cases spores are formed but there is no conjugation either before or after.

CHAPEL HILL, N. C.

EXPLANATION OF PLATE 55

Schizosaccharomyces octosporus Beyerinck

Figures 1–11. Normal stages of vegetative growth and division. × 1080.

Figures 12, 13. Elongated forms showing the beginning of hyphal development. × 1080.

Figures 14–25. Stages in conjugation and spore formation. × 1080.

* Ann. Myc. 8: 287. 1910.

THE RUSTS OF GUATEMALA—II*

Frank D. Kern

The first article of this series was published in 1907 in the Journal of Mycology, vol. 13, pp. 18–26. The general introductory remarks used there apply equally well to the present paper but since a considerable time has intervened it may be well at this time to again call attention to the principal points. The specimens upon which both papers have been based were collected in Guatemala by the late Professor W. A. Kellerman (except one specimen by Professor Wm. Trelease) and placed in the hands of the writer for identification and study. Professor Kellerman made in all four excursions for the collection and study of the Guatemalan flora. So rich were his collections of the rusts, however, that specimens secured during the first two excursions (with one or two exceptions) have sufficed for both this and the earlier report and there still remains a number which have not yet been determined.

Ravenelia mimosae-albidae Dietel.—— On *Mimosa albida floribunda* Rab. (host no. 5222, det. by B. L. Robinson), Antigua, Depart. Sacatepéquez, Feb. 18, 1905, no. *5360*.

Cionothrix praelonga (Winter) Arth.—On *Eupatorium populifolium* H.B.K. (host det. by J. M. Greenman), Los Amates, Depart. Izabal, alt. 90 m., March 15, 1905, nos. *5301*, *5302*.

Calliospora Diphysae Arth.—On *Diphysa* sp., Palmar, Depart. Quezaltenango, Feb. 11, 1906, no. *5459*.

A little known but characteristic species hitherto known only from the type locality, Rio Blanco, Guadalajara, Mexico.

Puccinia gregaria Kunze.—On *Xylopia* sp., Los Amates, Depart. Izabal, alt. 90 m., March 15, 1905, no. *5330*.

A very interesting species because of the odd characters of the teliospores. The apex of the upper cell and the base of the lower cell have the wall thickened and over these areas the spinulose papillae are much longer than on the sides. The species has

* Contributions to Guatemalan Mycology—V. (The first three papers in this series were by W. A. Kellerman, the fourth by the writer.)

also been called *Dasyspora faveolata* by Berkeley and Curtis and is the type of their genus *Dasyspora,* which has been maintained by Arthur to include the *Puccinia*-like species which possess only pycnia and telia in their life-cycle. The Guatemalan specimen has pycnia accompanying the telia.

PUCCINIA LIPPIAE Speg.—On *Lippia myriocephala* Cham. & Schlecht. (host no. 5209, det. by John Donnell Smith), Laguna, Depart. Amatitlan, alt. 1200 m., Jan. 20, 1906, no. *5451* (in part).

The teliospores of this species are also very unusual on account of the whorls of branched appendages near the base of the pedicels.

PUCCINIA POLYGONI-AMPHIBII Pers.—On *Polygonum* sp., Laguna, Depart. Amatitlan, Jan. 25, 1906, no. *5392.*

PUCCINIA INANIPES Diet. & Holw.—On *Eupatorium tubiflorum* Benth. (host no. 5195, det. by J. M. Greenman), Volcano Atitlan, Depart. Solalá, Feb. 16, 1906, no. *5314.*

PUCCINIA ELEOCHARIDIS Arth.—On *Eleocharis* sp., Palmar, Depart. Quezaltenango, Feb. 11, 1906, no. *5419.*

UROMYCES APPENDICULATUS (Pers.) Fries.—On *Phaseolus atropurpurea* Moc. (host no. 4797), Laguna, Depart. Amatitlan, alt. 1200 m., Feb. 5, 1905, no. *5373.*

The host has been examined by J. K. Small, who is somewhat doubtful about the specific determination owing to its fragmentary condition.

UROMYCES LEPTODERMIS Sydow.—On *Panicum barbinode* Trin. (host det. by A. S. Hitchcock), Laguna, Depart. Amatitlan, alt. 1200 m., Feb. 5, 1905, no. *5364.*

UROMYCES PROËMINENS (DC.) Pass.—On *Euphorbia lasiocarpa* Klotzsch. (host det. by C. F. Millspaugh), Laguna, Depart. Amatitlan, alt. 1200 m., Jan. 17, 1906, no.*5404; E. adenoptera* Bertol, Los Amates, Depart. Izabal, alt. 90 m., Jan. 5, 1908, no. *7036.*

UROMYCES RUBI Diet. & Holw.—On *Rubus glaucus* Benth., Guatemala, Depart. Guatemala, alt. 1465 m., Feb. 12, 1905, no. *4625;* Antigua, Depart. Sacatepéquez, Feb. 18, 1905, nos. *5319, 5320, 5321; Rubus poliophyllus* Focke (host no. 4775), Antigua, Feb. 18, 1905, no. *5363;* Volcano Atitlán, Depart. Sololá, Feb. 16, 1906, no. *5415.*

Nos. *4625* and *5363* were erroneously reported in the first article (Jour. Myc. **13**: 20) as *Kuehneola albida.* It was noted there that the markings of the urediniospores of no. *5363* are much coarser than is typical in that species. This coarse spinosely-echinulate surface is characteristic of *U. Rubi.* The host of no. *5363* was determined by John Donnell Smith, all the others have been determined by P. A. Rydberg with an indication of some uncertainty in nos. *4625* and *5319*.

Uromyces Gouaniae sp. nov.—Pycnia and aecia unknown.

Uredinia hypophyllous, scattered, small, inconspicuous, punctiform, roundish, chestnut-brown; paraphyses encircling the sori, clavate or cylindrical, 10–16 × 30–40 μ, somewhat incurved, the wall colorless, thin, about 1 μ; urediniospores obovoid or broadly ellipsoid, 18–19 × 21–26 μ, the wall light cinnamon-brown, 1.5–2 μ thick, evenly and sparsely echinulate; pores 2, occasionally 3, superequatorial.

Telia resembling the uredinia, slightly darker; teliospores broadly ellipsoid or ovoid, 18–23 × 26–29 μ, the wall chestnut-brown, with a slightly paler umbo, moderately thick, 2–2.5 μ, thicker above, 4–5 μ, evenly and moderately verrucose; pedicel tinted, once to twice length of spore.

On *Gouania domingensis* L., Laguna, Depart. Amatitlan, alt. 1200 m., Jan. 25, 1906, no. *5391*.

There is no other species of *Uromyces* known on this or any closely related host. The general characters of this species are paralleled in a very interesting manner by *Puccinia Gouaniae* Holw., the important difference between the two being the number of cells in the teliospores. *Uredo Gouaniae* Ellis & Kelsey is doubtless the uredinial stage of *Puccinia Gouaniae* Holw. The host of the Guatemalan specimen has been determined by J. N. Rose.

AECIDIUM LORANTHI Thüm.—On *Loranthus* sp., Guatemala, Depart. unknown, Feb. 27, 1902, *Wm. Trelease.*

UREDO MALVICOLA Speg.—On *Malvaviscus* (host no. 5238), Mazatenango, Depart. Suchitepéquez, alt. 330 m., Feb. 28, 1905, no. *5375*.

The host of this collection has been examined by J. N. Rose, who suggested this determination with some doubt owing to the very fragmentary condition of the specimen.

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NEWS AND NOTES

Dr. C. E. Fairman, of Lyndonville, New York, spent some time at the Garden in August consulting the library and mycological herbarium.

Mr. B. O. Dodge, of Columbia University, collected fungi in Bermuda in August, and later visited Whitepost, Virginia, to obtain certain fleshy species.

Dr. C. L. Shear, of the Department of Agriculture at Washington, spent September 18 and 19 at the Garden, consulting the Ellis Collection of fungi.

Mr. Wilmer G. Stover has been appointed assistant professor of horticulture and botany in the Agricultural and Mechanical College of Oklahoma.

Dr. Gertrude S. Burlingham spent the summer near West Wardsboro, Vermont, continuing her study of the genus *Russula* for North American Flora.

Dr. Bruce Fink, professor of botany at Miami University, Oxford, Ohio, spent most of August and a part of September at the Garden, continuing his studies of North American lichens.

According to Pantanelli, *Diaporthe parasitica* has been successfully inoculated into Italian chestnuts, and the strictest quarantine regulations have been recommended to prevent the introduction of this parasite into Italy.

Among the principal diseases of sugar cane considered by L. C. and A. Maublanc in a recent series of articles, *Schizophyllum commune, Marasmius Sacchari,* and *Ithyphallus impudicus* occupy an important place.

Through the experiments of Bonnier, Matruchot, and Combes (Compt. Rend. 152: 652–659. 1911), it has been demonstrated that the air of forests contains nearly three hundred times as many spores of fungi as of bacteria, and that at high altitudes the number of spores of all kinds present in the air is much reduced.

A canker of the chestnut in southern Europe somewhat similar to that caused by *Diaporthe parasitica* in America, is claimed by Briosi and Farneti to be due to *Melanconis perniciosa,* which, according to these authors, is distinct from *Melanconis modonia* causing black canker of the chestnut in Brittany.

P. Vuillemin has called attention to a minute fungus, *Cicinnobolus Cesatii Euonymi,* which is parasitic on the oak oidium in the forests of France, and suggests that this prevalent disease may be held in check elsewhere by the introduction of the parasite. The oidium has been abundant in the eastern United States in recent years.

Dr. W. A. Murrill visited Stockbridge, Massachusetts, on September 4 and 5, and returned with a large number of fleshy fungi, collected with the assistance of Dr. W. Gilman Thompson and Mr. Hoffmann. The invasion of the chestnut canker at several points in the vicinity of Stockbridge was also investigated and specimens of infected branches secured.

A disease of plum trees known as "silver-leaf," caused by *Stereum purpureum,* has been investigated quite thoroughly in England by the Duke of Bedford and S. U. Pickering, who claim that the discoloration of the leaves is due to their cells becoming partially disconnected, owing to disturbance in nutrition by poisons formed by the growing fungus. No satisfactory treatment has been discovered.

Dr. H. D. House, of the Biltmore Forest School, has done considerable collecting the past season in Michigan and Oregon.

Fleshy fungi have been scarce, but a number of interesting woody forms have been found and studied in relation to their hosts. Dr. House remarks in a recent letter from Oregon that "except for *Ganoderma oregonense* and *Echinodontium tinctorium*, the woody fungi and wood-destroying fungi do not appear to differ much from those in the East, the same species being common."

The report of the state botanist, Dr. C. H. Peck, for 1910 is a pamphlet of 86 pages and 6 colored plates, containing descriptions of 22 new species of New York fungi and 31 new fungi from other states. *Boletus albus, Cantharellus aurantiacus, Lactarius camphoratus, Lactarius lignyotus,* and *Lycoperdon atropurpureum* are figured and described at length in continuation of a list of edible fungi. Among notes on species, *Clitocybe dealbata sudorifica* is described as causing profuse perspiration, having been used by Mr. Howland, of Saratoga Springs, to break up a cold. Very serviceable descriptive lists of the New York species of *Hypholoma* and *Psathyra* conclude this excellent report. Dr. Peck has been assisted in its preparation by Mr. S. H. Burnham.

The recent epidemic of mushroom poisoning, during which about thirty persons lost their lives within a few weeks in the vicinity of New York City alone, was undoubtedly due to the prevalence of the white form of the deadly amanita, or "destroying angel," in the groves and woodlands of this region. After the heavy and continued rains of the last week in August, following a prolonged drought, mushrooms of many kinds sprang up in great quantity, the white form of the deadly amanita being conspicuous because of its color and large size, as well as because of its abundance.

The fatalities were mainly among the ignorant and foreign-born, who, to my personal knowledge, often collect everything they find in the form of a fleshy mushroom as they scour a piece of woodland, at times leaving behind them the "cups" of the poisonous species imbedded in the soil. These same persons not only eat the specimens themselves, but also sell them to shopkeepers and share them with their friends. The white form of

Amanita phalloides, especially when young and broken away from its swollen base, does not appear so very different to these collectors from the common field mushroom, *Agaricus campestris*, which is often pure white above and has its vivid pink gills hidden from sight by the veil in the younger stages. The two species are, however, very widely distinct, and persons incapable of distinguishing them would do well to abandon at once the rôle of mycophagist.

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New names, and the final members of new combinations, are in **bold face type**